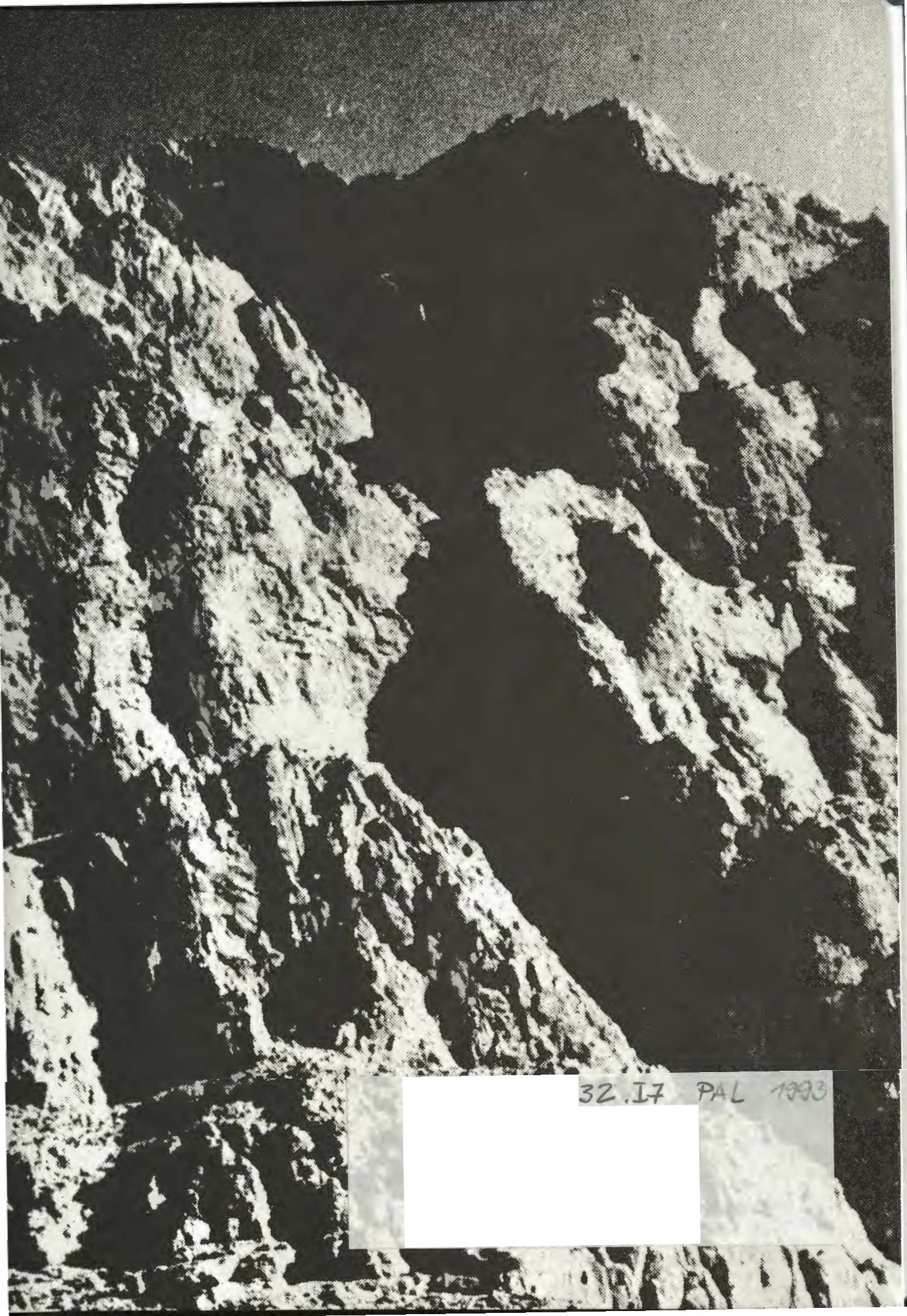

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Deborah I. Olszewski
Harold L. Dibble
Editors

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Foreword

Ezat O. Negahban

When one considers the limited amount of archaeological research and excavation on the Stone Age period in the Iranian Plateau and the Zagros-Taurus ranges over the past several decades, one can appreciate the value of the present volume on Paleolithic research in this region.

Although many archaeological sites have been excavated and studied in the light of the development of human society in the period since the beginning of agriculture and domestication of animals, resulting in a fairly clear picture of this development throughout most parts of the Fertile Crescent, there has been much less study of the Stone Age in this area. Until the late 1930s such activity included the French expedition, directed by Jacques De Morgan, in the Caspian area and the survey by Henry Field in the Fars region. From the late 1940s on several more organized studies were carried out, including the expedition of Carleton Coon, which resulted in the discovery of several caves in the Elburz-Zagros region that produced valuable information about the Middle Paleolithic and Mesolithic periods. During the 1950s, 1960s, and 1970s more research on this period, although still insufficient, was carried out by scholars and scientific institutions, including the Henry Field survey in Luristan; the Robert Braidwood expedition in Kermanshah, Sara Mahidash region; the expedition of Frank Hole and Kent Flannery, and later J. Speth, near Khorramabad in Luristan; the expedition of C. B. N. McBurney in Keyaram in Mazandaran and Ali Tappeh near Behshahr; the surveys of G. W. Hume in Baluchistan and J. T. Marucheck in southeastern Iran; the survey of William Sumner around Shiuraz; the survey of Henry Wright in Khuzistan; the survey of Hind Kooros in eastern Azerbaijan; the survey of A. Arai and C. Thibault in Khorasan; the survey of P. Mortensen in Luristan and Kermanshah; and the study of R. Singer, J. Wymer, and R. S. Solecki in Azerbaijan.

The present volume is a valuable collective contribution by several scholars to the study of Paleolithic material uncovered from caves, rockshelters, and open sites in the Zagros-Taurus ranges. Although some of the material discussed was collected as long as several decades ago, detailed analysis has only now been undertaken, allowing comprehensive publication. It is indeed fortunate that the previous limited publication of this material is being expanded by the efforts of these scholars to bring more light to the early prehistoric picture of this vast and important region. Scholars of the period will particularly appreciate this study now when, because of the political upheavals of the past decade and a half, scientific survey and excavation of archaeological sites are almost nonexistent in Iran and very limited in the rest of the Near and Middle East.

I can only wish the best of success to the authors of this valuable volume and express the indebtedness of all scholars of Iranian prehistoric archaeology to the great achievements of these contributors.

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and
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University of Tehran

Editor's Preface

Deborah I. Olszewski and Harold L. Dibble

All volumes have a history, and this one is certainly no exception. The original impetus began, one might say, with the permanent loan, by Robert Braidwood, of the Warwasi Rockshelter (Iran) collections to The University Museum of Archaeology and Anthropology, University of Pennsylvania. One of us (Dibble) immediately began to work on the Mousterian Middle Paleolithic levels, and shortly thereafter, the other (Olszewski) started on the Baradostian Upper Paleolithic and the Zarzian Epipaleolithic materials. Within a relatively brief period of time, we became convinced that a number of researchers might be persuaded to discuss Paleolithic materials from the Zagros-Taurus arc, a region sadly underrepresented in the archaeological literature of the Paleolithic due to various recent upheavals in that part of the world. The fact that a number of collections are housed outside the Zagros region, and thus are available for study should anyone show the inclination, spurred us to action.

We began by proposing participation in a Zagros symposium to several individuals who had either worked in the area or who had access to pertinent collections. This symposium was realized at the Society for American Archaeology meetings, held in Las Vegas, Nevada, in April 1990. Although not all the original members of the symposium were able to contribute to this volume, the chapters by Baumler and Speth, Dibble and Holdaway, the Soleckis, Minzoni-Déroche, Mortensen, and Olszewski (on the Baradostian) represent revision of papers first presented in Las Vegas.

The papers included here are weighted toward the Middle Paleolithic time range, due in part to the research interests of many of the participants, and to still incomplete analyses of Upper Paleolithic and Epipaleolithic materials from a number of existing collections. Those papers dealing primarily with the Middle Paleolithic include the report on Kunji Cave by Baumler and Speth, on Warwasi Rockshelter by Dibble and Holdaway, on Karain Cave E by Yalçinkaya et al., and on Shanidar Cave by the Soleckis. The chapters by Minzoni-Déroche and by Mortensen cover more than one temporal period. Minzoni-Déroche offers Middle and Upper Paleolithic descriptions of sites in the Taurus contrasted with previously known information from the Zagros region, while Mortensen discusses the entire range from the Lower Paleolithic through the Epipaleolithic in northern Luristan, Iran. Olszewski has written two separate chapters, one dealing with the Warwasi late Upper Paleolithic, and the other with the Warwasi Epipaleolithic.

We are proud of the fact that this volume presents, for the first time, detailed research on Kunji Cave (Baumler and Speth), Warwasi Rockshelter (Dibble and Holdaway, Olszewski), the open-air site at Pal Barik (Mortensen), and the cave sites at Mar Gurgalan Sarab and Mar Ruz (Mortensen), and new information about the deposits at Shanidar Cave (Solecki and Solecki), Karain Cave E (Yalçinkaya et al.), the sites of the Taurus arc (Minzoni-Déroche), and the survey sites from northern Luristan (Mortensen). We hope that these contributions will prove valuable both to our colleagues and to our understanding and interpretation of these relatively little known regions of the Middle East. We recognize that what we say in these pages represents in some manner the culmination of research programs that in some cases began over thirty-five years ago. We remain hopeful that field research in the Zagros will be possible at some future date, but until then, stress that there is much valuable work to be done on existing collections.

Deborah I. Olszewski
Harold L. Dibble
February 1993

1

A MIDDLE PALEOLITHIC ASSEMBLAGE FROM KUNJI CAVE, IRAN

Mark F. Baumler and John D. Speth

INTRODUCTION

In line with other recent efforts (Dibble and Holdaway, this volume; Dibble 1984a; Bewley 1985; Smith 1986; Dibble and Holdaway 1990), this paper is intended to bring forward the results of Paleolithic research in the Zagros Mountains of southwestern Iran, conducted over twenty years ago at the site of Kunji Cave. Specifically, we present here for the first time a typological and technological description of the Middle Paleolithic industry from this important locale. In presenting these data and our understanding of them, we hope that we can broaden the perspective and the discussion of those unique Paleolithic assemblages that have collectively come to be known as the "Zagros Mousterian" (Skinner 1965; Smith 1986).

EXCAVATION BACKGROUND

Kunji Cave is a Middle Paleolithic or Mousterian site located on the barren rocky slopes that form the northeastern flanks of the Khorramabad Valley, a broad, flat intermontane trough in the Zagros Mountains of Luristan, in southwestern Iran (Fig. 1.1). The site is situated at an elevation of about 1300 m above sea level, approximately 6 km south of the modern town of Khorramabad (Fig. 1.2). From the mouth of the cave, some 60-70 m above the valley floor, one has an almost unobstructed view of the surrounding countryside, including a small, low hill—Gar Arjeneh—that rises islandlike above the valley floor about 1.5 km west of the site (Fig. 1.3). The valley is drained by a perennial spring-fed stream, the Ab-i-Khorramabad, which passes within about 3 km of the site to the northwest. A seasonally dry tributary of the Ab-i-Khorramabad flows into the valley about 2.5 km south of the site.

The cave itself is a large dome-shaped chamber that appears to have developed along the axis of a small, sharply folded, almost V-shaped syncline in the Upper Cretaceous limestone formations that border the valley (Fig. 1.4). The base of the "V" collapsed in the distant past, forming a small cavity that was subsequently enlarged by further collapse, erosion, and solution. An illustration of a similar though more exaggerated case may be seen in Oberlander's *The Zagros Streams* (1965:76). The mouth of the cave, which faces almost due west, is about 18 m wide and slightly over 4 m high. The ceiling on the interior rises to a maximum height of about 8 m above the present floor near the rear of the cave and then descends rapidly to form the back wall roughly 28 m in from the entrance (Fig. 1.5).

During the spring and summer of 1969, one of us (JDS), then a graduate student in the Museum of Anthropology at the University of Michigan, undertook large-scale excavations in Kunji Cave. This research, partially funded by a National Science Foundation Dissertation Improvement

Grant (GS-2402), was to have provided the data base for a doctoral dissertation focusing, in particular, on the spatial organization of activities on so-called living floors in a site that previous research in 1963 by Hole and Flannery (1967) had singled out as the principal Middle Paleolithic "base camp" settlement in the valley.

Kunji was first reported to the archaeological world by Henry Field (1951). Recognizing its potential importance, Hole and Flannery (1967) visited the site in 1963 and excavated a 1 x 10 m test trench that extended along the cave's central axis from just inside the present-day dripline near the mouth of the cave toward the rear wall (see Fig. 1.5). Their test revealed what appeared to be a well-preserved and stratified sequence of Holocene and Late Pleistocene deposits, which they divided into twelve natural stratigraphic levels, grouped into three principal units (Fig. 1.6). These units, from top to bottom, were (1) approximately 1 m of ceramic-period deposits—largely Uruk in age—containing the remains of cobble wall foundations of probable huts or sheep/goat pens, with small numbers of possibly earlier painted wares intermixed with Mousterian artifacts near the base of the sequence; (2) some 30-40 cm of fine-grained sediments rich in Middle Paleolithic stone tools and animal remains stratified within thin, alternating lenses of white-and-black ashy deposits; and (3) an underlying 70-80 cm or so of coarse-grained Late Pleistocene sediments containing dense concentrations of angular limestone rock chips and rubble, and larger slabs and blocks spalled from the walls and roof of the cave. Within these lowermost deposits were found occasional Mousterian implements, animal bones, and scattered flecks of charcoal and patches of ash. No evidence of an Upper Paleolithic occupation was evident in the sequence exposed in the 1963 test excavations; a few small, isolated blocks of breccia with embedded Upper Paleolithic and/or Epipaleolithic bladelets found in the 1969 work, however, indicate that deposits of this age had once been present in the cave but had probably been removed by erosion during the Late Pleistocene or early Holocene (see below). Hole and Flannery (1967:153) obtained two conventional radiocarbon dates from the second level, or "Main Component of the Mousterian," both yielding infinite dates in excess of 40,000 years b.p. (SI-247, SI-248).

As previously described (Speth 1971), the return to Kunji for systematic excavations in 1969 yielded several surprises. Not the least of these was the discovery that both the upper ceramic-period levels and the deposits of the "Main Component" of the Middle Paleolithic had been seriously disturbed prehistorically by one or more episodes of porcupine and rodent burrowing. The extent of this disturbance was impressive, leaving, on average, less than one-half of the ceramic-period deposits and less than one-third of the Mousterian deposits intact (Figs. 1.7 and 1.8). This disturbance was not clearly evident in Hole and Flannery's 1963 test trench; somehow, by one of those curious accidents of sampling, their excavations hit one of the few relatively undisturbed portions of the site that remained. The few tunnels that did appear in section in the walls of their test trench looked very much like cultural features; their true nature did not become clear until they were exposed over a large area in 1969.

In most cases, upon excavation, the burrows proved to be distinct and easy to follow. In fact, the walls of many of the dens and tunnels were lined by a thin veneer of red, water-laid clay, and their fill was generally a soft, homogeneous, dark-brown silty sediment lacking the clear stratification and compactness that characterized virtually all the site's in situ deposits, regardless of time period. Disturbance was so severe in some of the Uruk-period deposits that most of the sherds and animal bones were found within the dens and tunnels, leaving the in situ deposits almost devoid of any artifacts whatsoever. The animals responsible for the disturbance during this phase of the site's occupation apparently systematically carried almost everything they encountered on the cave floor into their burrows.

Burrowing penetrated into virtually all the Middle Paleolithic deposits as well, and again a lot of the Mousterian artifacts and faunal remains had become concentrated in the tunnels. Fortunately, however, despite the extensive burrowing activity, large-scale mixing of cultural material from the two time periods did not occur. Almost no Mousterian items found their way into the overlying Holocene deposits, and very few younger materials were carried downward into the Middle Paleolithic levels. What limited mixing did occur was confined largely to a relatively thin zone at the base of the ceramic-period deposits. This mixed horizon seems to be the combined product of terminal Pleistocene and/or early Holocene erosion that stripped out virtually all traces of Upper Paleolithic and

Epipaleolithic occupation, and subsequent early ceramic-period cultural activities, such as hut and pit construction, that disturbed the underlying Middle Paleolithic sediments.

Why there was so little mixing of Middle Paleolithic and Holocene cultural materials is a mystery, given the intensity of disturbance in both periods. There may, in fact, have been at least three distinct episodes of burrowing. The first one may have occurred late in the Pleistocene or, more likely, relatively early in the Holocene, prior to intensive ceramic-period use of the site. This phase disturbed the Middle Paleolithic deposits in the cave. The second phase took place during the Uruk, but, for reasons discussed below, may not have penetrated into the Pleistocene layers. The third episode of porcupine burrowing is essentially modern, as indicated by the presence, at the time of the 1969 excavations, of recent burrows with fresh quills in them.

That the Uruk-period porcupine and rodent disturbance failed to penetrate the Pleistocene levels is due, in large part, to the presence of a laterally continuous, 15–20-cm-thick grayish white layer of partly burned sheep and/or goat dung within the ceramic- period deposits. This fecal layer was so compact that the younger phases of burrowing activity rarely if ever intruded into the underlying Mousterian layers. The deposit, in fact, was so consolidated that it had to be broken apart in blocks during excavation with a geology hammer. In addition, near the base of the ceramic-period sequence was a horizon of large cobbles, either the collapsed remains of a large enclosure or retaining wall on the slope near the cave's mouth or the fallen wall foundations of huts or sheep and goat pens. Whatever their original function, they formed a nearly continuous layer of cobbles over large sections of the cave floor, in many places more than 30 cm thick, which probably also helped to deter larger animals like porcupines from burrowing into the Mousterian layers from above (Fig. 1.9).

The hiatus separating the Mousterian levels from the overlying ceramic-period deposits deserves further comment. Although no in situ Upper Paleolithic or Epipaleolithic levels were encountered in the cave, several isolated chunks and blocks of highly cemented "breccia," seldom larger than about 20 cm in diameter, were found scattered within a thin, patchy horizon of reddish brown water-laid clay that directly capped the Mousterian deposits. These scattered pieces of brecciated deposit, which contained embedded bladelets, pieces of debitage, and animal bone splinters, testify to the probable former presence of an Upper Paleolithic and/or Epipaleolithic occupation in the site, which was subsequently stripped almost entirely from the cave by one or more periods of erosion at the end of the Pleistocene or early in the Holocene. Occasional medial fragments of stalactites (or stalagmites) scattered within the water-laid clay may also point to such an erosional episode in the cave. Some of these stalactites were quite large, with medial diameters in excess of 5 cm.

That Upper Paleolithic or Epipaleolithic deposits once existed in the cave is strengthened by observations made by Henry Field, the first archaeologist to test Kunji. Field (1951:91, footnote 22) reported finding "typologically Upper Palaeolithic implements" in a small test "in the center of the entrance to this rockshelter." He also noted that he had to remove "six feet of overload" in the process. While the precise location of Field's test pit was never determined, it most likely was on the terrace in front of the mouth cone. Behind the cone no in situ deposits with tools of Upper Paleolithic affinity were encountered in either 1963 or 1969. Moreover, Field makes no mention of Early Dynastic stone-lined burial chambers, which he would surely have encountered had his pit been directly in the mouth cone (see below).

The original configuration of the cave filling is not entirely clear. Sediments at one time apparently nearly filled the mouth of the cave, and the interior surface or floor sloped gently downward toward the rear wall (see Fig. 1.6). The prominent cone of sediment in the cave mouth likely formed from the natural accumulation of material washed down from the steep rocky slopes above the cave, although the construction of a series of Early Dynastic stone-lined burial chambers or tombs in the entrance created an artificially mounded area that became the nucleus of the growing mouth cone. Prior to the construction of these tombs, the deposits in the cave (like the underlying bedrock) dipped steeply toward the front.

More recent cultural activities also influenced the configuration of the deposits in the cave. Because of its size and protected location, the Iranian army at one point used the cave to house munitions and in so doing removed the upper 2 m or more of deposit inside the cave to create a flat interior floor (see Fig. 1.6). The cone of sediment at

the mouth was left in place, although its interior face was truncated to form a nearly vertical wall for the storage chamber within the cave. A small gap was also cut through the cone along the north wall of the cave to serve as a restricted entrance. Some of the sediment removed from the interior at this time appears to have been added to the cone at the mouth, contributing to its present size and form, although much of the cave fill was apparently dumped down the front slope to form a broad, flat, artificial terrace.

The Late Pleistocene and Holocene deposits remaining in the cave after the army had leveled the floor all dipped steeply downward toward the mouth (see Fig. 1.6). At the interior face of the mouth cone, where Hole and Flannery's 1963 test trench began, deposits of probable Uruk and Early Dynastic age form the present floor, whereas the Mousterian levels are over 1 m below the surface. However, at the interior end of the 1963 trench, 10 m toward the rear wall of the cave from the interior face of the mouth cone, the Mousterian levels are exposed at the floor surface. From there to the rear of the cave, a distance of approximately 17 m, only extremely small-scale testing has been undertaken, but there is no surface evidence of in situ Mousterian deposits. Whatever culture-bearing deposits may once have existed in this most interior part of the cave were likely destroyed when Kunji was converted into a munitions depot.

The work at Kunji in 1969 began by laying out a 1 m grid system over the entire floor of the cave in such a way that it incorporated Hole and Flannery's 1 x 10 m test trench (see Fig. 1.5). Their trench had been oriented more or less perpendicular to the interior face of the mouth cone (and roughly parallel to the long axis of the cave), rather than with respect to the cardinal directions. Nevertheless, the long axis of their trench deviated only slightly from an east-west orientation. Because the 1969 grid system was set up to incorporate the earlier excavation, it too deviated, again by only a few degrees, from the cardinal directions. The 1969 grid used letters to designate the 1 m units along the "north-south" axis (with A to the north) and numbers to designate the 1 m units along the "east-west" axis (with zero denoting the square at the interior face of the mouth cone). Thus, squares were designated A-0, A-1, A-2, B-0, B-1, B-2, etc. The unit at the west end of Hole and Flannery's 1963 trench (their square 00) became square K-0 in 1969.

Unfortunately, the zero line for the 1969 grid system was defined along the interior face of the mouth cone on the assumption that all of the excavation would focus on the cave interior. However, once the terribly disturbed nature of the Mousterian deposits in the interior became evident, excavation was shifted to the area of the mouth cone itself, beyond (i.e., west of) the zero line of the grid system, necessitating the use of cumbersome and sometimes confusing negative numbers to designate squares in the front zone of the cave (e.g., A-[-1], A-[-2], B-[-1], B-[-2], etc.).

The excavations began by clearing out Hole and Flannery's test trench and remapping their profiles. This made it possible to tie the results of the 1969 excavations directly to those of the previous project, and provided an ideal starting point for the new work. Two large blocks of contiguous 1 m squares were then opened adjacent to the 1963 test trench, exposing a total surface area of 132 m^2 (including the 10 m^2 of the 1963 test trench). Wherever possible, excavation followed the natural stratigraphy of the deposits. All sediment from the ceramic periods was dry-screened through .5 cm mesh, and 2- to 4-liter geological/flotation samples were saved from each level in each square. As soon as the extent of porcupine and rodent disturbance in the ceramic-period levels became apparent, however, the strategy of excavation was altered so that the fill of all dens and tunnels was first removed over the entire area gridded off for excavation before systematic work resumed on the remaining in situ deposits on a square-by-square basis.

Despite the high degree of porcupine and rodent disturbance in the ceramic-period deposits, it was hoped that the underlying Mousterian levels remained intact, since no evidence was found that this system of burrows penetrated through the compact layer of sheep and goat dung or the layer below it of collapsed cobble walls. Thus, as work in the Mousterian deposits began, all items, lithic and bone, were carefully (and optimistically) piece-plotted and assigned individual sequential item numbers. All sediment was again dry-screened through .5 cm mesh and, as above, geological/flotation samples were saved from each level in each square.

It very quickly became apparent, however, that the Mousterian, like the overlying Holocene, deposits had suffered extensive damage from burrowing animals, again most probably porcupines, and the strategy of excavation was once

again altered to remove den and tunnel fill before proceeding to excavate in situ deposits. As noted earlier, this strategy demonstrated that less than 30% of the deposits of the "Main Component" of the Middle Paleolithic remained intact. Once the den fill had been removed from the entire excavation area, the in situ Mousterian age deposits resembled miniature black-and-white ashy pinnacles in a cratered lunar landscape (see Fig. 1.8). Needless to say, any attempt to piece plot lithics and bones was abandoned.

In a desperate attempt to find more intact Mousterian deposits, excavation was shifted to the area of the cone blocking the mouth of the cave (grid squares HIJK-0,[-1],[-2],[-3],[-4],[- 5]). However, because the deposits in the cave dipped steeply toward the entrance, more than 2 m of fill had first to be excavated in order to reach the Mousterian levels. As already noted, these Holocene age deposits proved to enclose a complex series of stone-lined burial chambers of probable Early Dynastic age, which required a great deal of time to excavate and record. Unfortunately, when the Mousterian levels were finally reached, they too proved to be as badly disturbed as those already examined inside the cave. At that point, after nearly six very frustrating months of tedious fieldwork, the excavations were terminated.

INITIAL LITHIC ANALYSIS

Kunji obviously proved useless for the sort of spatial investigation of in situ Middle Paleolithic "living floors" originally envisioned, and this research objective was abandoned. Nevertheless, a large sample of Mousterian lithics (approximately 2700 items) had been recovered from the site, and although many had come from the disturbed fill of porcupine and rodent dens, the collection was essentially unmixed with later materials, either Upper Paleolithic or Holocene. Only two bladelets of unusual raw material are obviously post-Mousterian intrusives. Thus, at the close of the fieldwork a new dissertation prospectus was developed to focus on an in-depth typological and technological analysis of the collection. For several months in 1970, therefore, one of us (JDS) began a detailed analysis of the Mousterian lithics, first sorting the material into Bordes's 63 traditional tool types and then recording an extensive series of metric and non-metric attributes on each specimen.

Included in these data were the percussion-axis length (the length measured perpendicular to the platform from the point of impact or apex); maximum length (i.e., the specimen's maximum dimension from the point of impact); the angle between the two length axes (as viewed from the interior, or "ventral," surface with the bulbar end toward the observer such that this value is zero degrees when the two axes are identical, or has values of plus or minus when the flake axis is to the right or left of the percussion axis, respectively); maximum width (perpendicular to the axis of percussion); butt-width distance (distance along the percussion axis from the platform to the point of intersection with the maximum width); platform thickness (measured across the surface of the platform, perpendicular to the interior surface at the point of impact); maximum platform width (at the interior surface); and specimen weight.

Numerous other attributes, both metric and non-metric, were also considered, and some were partly measured and coded. These included bulbar thickness; maximum specimen thickness; the presence, orientation, and size of eraillure scars; platform angle; the degree of longitudinal flake curvature; platform faceting; cortex amount and placement; the nature, frequency, and location of thermal damage (e.g., crazing, "potlids," color and luster changes); exterior (i.e., dorsal) scar patterns; characteristics of the distal end of the flake (e.g., hinge fractures, "feathering" terminations); and breakage patterns (e.g., proximal, medial, distal, lateral).

Prior to analysis, all the Mousterian lithics were assigned an individual specimen or item number (i.e., numbers 1–2,713). The order in which the pieces were numbered deserves comment, since several non-metric attributes were coded only for the first several hundred specimens (or in a few cases the first 1,500 specimens) before being excluded in order to expedite coding of a basic set of metric attributes on the entire collection (see below). Numbering of specimens was done after the collection had first been presorted into Bordes's tool types. Although this initial sorting was only a rough approximation of Bordes's classification, and many tools were later reassigned to different types as research progressed, the sequence of specimen

numbers nevertheless broadly parallels the order of Bordes's typological categories.

The coding of both metric and non-metric attributes then proceeded more or less sequentially by item number. This means that some of the non-metric attributes that were dropped after only a few hundred flakes had been coded (e.g., frequency of thermal damage) are not necessarily representative of the collection as a whole, but instead reflect values primarily for retouched pieces and, given their high proportion in the collection, more specifically just for Mousterian points and side-scrapers. Nonetheless, several of the non-metric attributes (e.g., platform faceting) were coded for the first 1,500 items, a sample that includes virtually all the retouched pieces and quite a few of the unretouched flakes as well. Finally, a few non-metric attributes were coded for the entire collection (e.g., cortex amount and placement).

After more than three months of tedious coding (and putting off the more essential but also more painful stage of formulating an explicit problem to be addressed by all these data), a trial sample of metric attributes on about 700 complete flakes was analyzed by computer to see what kinds of "interesting" patterns would emerge that might be worth exploring further. Looking back some twenty years later, the outcome of this fruitless exercise should have been obvious from the outset. Reams of computer output essentially proved that flake length and flake width were significantly and positively correlated with flake weight! Most of the other scatterplots appeared as if they had been produced by a random-number generator.

Over and over again during the laborious process of generating and coding this mass of data, several questions kept surfacing: What are the fracture mechanisms that actually produce the features of a typical flake such as the bulb and cone of percussion, eraillures, hinges, and the like? What are the most appropriate ways to measure and record these features? To what extent are the many measurements archaeologists typically make of these features interdependent and hence largely or entirely redundant? And in what way might these measurements actually enlighten us about Middle Paleolithic stone tool technology, and ultimately human behavior? In 1970 the archaeological literature was still strangely silent about the mechanics of the fracture process that lay behind the production of stone tools by both percussion and pressure, despite the existence of a vast engineering literature on the fracture of brittle, flint-like materials such as glass and ceramics. Hence, the decision was at last made to set aside the Kunji material and focus instead on a literature review and experimental study of how brittle materials such as glass actually break under controlled impact conditions (Speth 1972, 1974, 1975, 1981). Perhaps the major value of these exploratory endeavors was a clearer understanding of what parameters were actually involved in the fracture process. Since these initial efforts in the 1970s, of course, many studies, both experimental and replicative, have appeared and the entire process is now much better understood (e.g., Bonnichsen 1977; Cotterell and Kamminga 1979, 1987; Dibble and Whittaker 1981; Faulkner 1972; Lawn and Marshall 1979; Tsirk 1979).

Although a few of the measurements made in 1970 on the Kunji artifacts were used in attempts to evaluate the fracture models derived from the engineering literature (e.g., Speth 1972:48-49), the lithics themselves remained in boxes until 1985, when Speth spent a semester at the University of Arizona. Here the two authors met and agreed to undertake a joint study of the collection, with the intention of publishing a basic description of the assemblage and thereby finally making these data available to the profession. Speth finished the measurement and coding of a minimal set of basic metric and non-metric attributes for every specimen, while Baumler retyped the collection and recorded several additional observations on selected samples, including exterior (dorsal) scar pattern, measures of retouch intensity, and other attributes of tool morphology. The discussion and analysis that follow are the product of this joint venture.

Finally, it should be pointed out that the antiquities laws of Iran in 1969 required that all collections from archaeological excavations such as Kunji be split 50–50 between the Archaeological Service of Iran and the excavator's institution. Moreover, the excavator normally was permitted to exercise little or no control over which "half" of the collection would be selected to remain in Iran. Additional "choice" items could also be retained by the Archaeological Service. Fortunately, given the Paleolithic focus of the Kunji project, the Iranians very graciously agreed to keep 100% of the ceramic-period lithics, as well as several whole pots and other items from the Early Dynastic tombs in the cave mouth, permitting the Museum of Anthropology of the University of Michigan to maintain the possession and the unity of the entire

Mousterian sample from the 1969 excavations. The Mousterian lithic materials have been accessioned and catalogued into the Museum's permanent collections under catalog numbers 58864 through 58911. It is this complete 1969 collection that is described below; none of the material recovered by Hole and Flannery in their test excavations at Kunji in 1963 is included here. Preliminary data on their material have been published elsewhere (Hole and Flannery 1967).

THE KUNJI LITHIC ASSEMBLAGE

As noted above, a total of 2713 pieces of chipped stone constitute the lithic sample from the 1969 excavations at Kunji Cave. These include all pieces recovered during excavation, as well as many tiny chips and spalls that derive from the processing of geological/flotation samples. Although most of the sediment samples were hand-sorted to remove larger artifacts and debitage (i.e., pieces greater than about 5 mm), only a few were systematically processed for the tiny pieces of flaking debris that were quite abundant in at least some of the samples. Regrettably, many of these unprocessed or partly processed bags have been discarded over the past twenty years, hence the frequency and character of pieces smaller than .5 cm must be considered tentative. Of the total sorted specimens, 2639 were present in the collection at the time of reanalysis in 1985 and 1986 (including two obvious intrusives from post-Mousterian levels). The remaining 74 Mousterian specimens could not be relocated and are presumably lost. Fortunately, however, a wide variety of relevant typological and metric data on these missing items had already been collected during the original analyses in 1970. These data are incorporated, whenever possible, into our discussion here, although this results in some variation in the total counts for different variables.

ASSEMBLAGE CHARACTERISTICS

A full range of lithic reduction products and byproducts are represented by the Kunji collection (Table 1.1). Included are retouched flakes, unretouched flakes (cortical and non-cortical), cores, and debris. In this study, pieces of debris are distinguished from broken flakes or flake fragments following the criteria advanced by Sullivan and Rozen (1985); that is, debris does not exhibit a clearly defined single interior (ventral) and exterior (dorsal) surface, nor does it generally show evidence of a flaking platform.

Nearly all the pieces in the Kunji collection belong to a single raw material type previously identified and described for the Zagros Paleolithic (e.g., Hole and Flannery 1967; Skinner 1965). This is a fine-grained cherty material, more specifically a multicolored, deep-sea-deposited silica known as "radiolarite." Two distinctly different colors dominate the Kunji material—a dark reddish brown, almost rust-colored variety, and a light to medium green variety. The reddish brown material is by far the most common. Both colors occasionally occur together on the same specimen. The radiolarite, regardless of color, is entirely opaque, even along the thin edges of flakes. Many of the specimens display small fissures or fractures, some infilled with very thin veins of quartz. A few also have small, quartz-lined vugs. These imperfections clearly interfered with the flaking process, causing fracture planes to deviate or jump suddenly from one level to another, and not infrequently causing specimens to break during the knapping process. Burned specimens sometimes also fractured along these imperfections. Aside from these fissures and other imperfections, however, the radiolarite chert tends to be quite homogeneous, displaying little evidence of banding by color or by texture. Smooth, rounded, grayish white to beige cortex on many of the radiolarite flakes indicates that small river cobbles were the primary source of this material.

In addition to radiolarite, there are also a few pieces of relatively fine-grained, dull to semilustrous chert and chalcedony. A variety of colors and textures are represented, suggesting that these materials were derived either from a number of different sources or from heterogeneous river cobbles. The nature of the cortex on the pieces again suggests the latter alternative to be the most likely. There are also several dozen dark gray to grayish black limestone flakes (Table 1.2). Lithic raw material type was coded only for the first 1500 numbered items; among these were forty limestone flakes (2.7%). Assuming this percentage to be a reasonably unbiased figure, there should be between about seventy and eighty limestone pieces in the entire collection (however, since many of the

first 1500 specimens were formal tools, it is possible that we are underestimating the number of limestone pieces in the unretouched debitage). The limestone flakes, for the most part, are unambiguous products of human flaking, showing clear platforms, bulbs, and exterior (dorsal) scars. Few (N=4), however, display formal retouch. None of the cores recovered in the 1969 excavations is made of limestone.

Items classified as "debris" (see above) in the Kunji collection range from small pieces of shatter, broken platforms, isolated "potlids," and eraillure "flakes" to a few amorphous chunks of fractured raw material not recognizable as core fragments. The majority of this debris is small. The mean maximum dimension of the 156 identified pieces is 2.4 cm and the average weight only 4.5 g (see Table 1.7h). No examples of debris with macroscopic evidence of utilization were observed.

Flakes in the sample encompass a variety of sizes and types from small trimming "chips" to prepared Levallois flakes (see below, "Typological and Technological Observations"). Although non-cortical flakes predominate, partial and, to a lesser extent, fully cortical flakes are common, representing 38% of the complete unretouched flake sample and 32% of all unretouched flakes (Table 1.1). Often the cortex on these occurs as backing or edging on flakes, both on those that are retouched and those that are not.

This tendency for cortex to occur along the edges of specimens, together with the relatively high percentage of pieces with remnant cortex in the assemblage as a whole (30%; see Table 1.9a), undoubtedly reflects, in part, the small size and rounded form of the available raw material. As stated above, we believe this to be predominantly cortex-covered river cobbles, probably averaging between 5 and 10 cm in maximum dimension and 200 to 500 g in weight. Such cobbles occur today in the Ab-i-Khorramabad within about 3 km northwest of Kunji as well as in the dry tributary roughly 2 km south of the site. Other drainages in the valley likely would also yield suitable radiolarite and chert cobbles for knapping, but systematic investigations of all raw material sources in the area have not been undertaken. Elsewhere, the use of cobbles as a material source has been similarly implicated in the enhanced production of naturally backed and partially cortical flakes (e.g., Jelinek 1975; Baumler 1988).

We expect that the nature and small size of the locally available raw material also constrained the size and form of the flakes and tool blanks produced at Kunji. The average maximum length of the measured sample of complete flakes is only 3.9 cm; the average width 2.5 cm (Table 1.3). Not unexpectedly, the average size of the complete retouched flakes exceeds that of the unretouched ones, but not dramatically so, particularly given the sample of very small flakes in the Kunji collection (Table 1.3). Even among the restricted sample of retouched tool blanks, the dimensions are still diminutive: average maximum length 4.3 cm; average width 2.6 cm. When compared to values recently published for Bisitun (Dibble 1984a), the Kunji flakes are shorter, though comparably broad (Bisitun: length 4.9 cm; width 2.4 cm). This cannot be explained entirely by the collection bias evident in the Bisitun unretouched piece sample; the retouched tools from Bisitun are similarly more elongated than those at Kunji (see, e.g., Table 1.16). On the other hand, the Kunji flakes appear to be larger overall than those described for Houmian by Bewley (1985), where the average length was only 3.1 cm and the average width only 1.9 cm. The Houmian retouched flakes, however, are more comparable: length 4.1 cm; width 2.4 cm. The amount of "excavator" bias introduced into these figures for the Houmian assemblage is unknown. Some differences, of course, might also stem from slightly different measurement practices.

The twenty-four complete cores in the Kunji assemblage are characteristically thin, small, circular or subcircular, "flattened" disc cores (or perhaps "nucleus Levallois inachevé"; see Bordes 1961:87, Pl. 99), very similar in all respects to those described elsewhere for the Zagros Middle Paleolithic (see Figs. 1.11 and 1.12). Radial or subradial flaking patterns on the face of the core are common; less frequent is evidence of a previous central flake removal. The mean length and width of the complete cores in the sample are 4.4 cm and 3.8 cm, respectively; the average weight is 32.1 g (see Table 1.7h). Even given the small size of the Kunji tools, it is apparent that these cores were incapable of producing many more suitable blanks, if any. The twenty-one broken core fragments, similar in form, size, and appearance to those that were discarded complete, may bear witness to this fact. Very similar cores have been described from many sites outside the Zagros, for example, at Jerf Ajla in Syria (Shroeder 1969), at Quneitra in Israel (Goren-Inbar 1990), at Karain in Turkey (Yalcinkaya 1988;

Yalcinkaya et al., this volume), and further afield in the Middle Paleolithic industries of northern Bosnia (Baumler 1988).

Finally, the amount of breakage in the assemblage is noteworthy, with about 40% (577 out of a total of 1385) of the unretouched flakes classified as broken (see Table 1.1). Much of this appears to be the result of normal, if not intensive, lithic reduction using radiolarite with fissures, vugs, and other imperfections. However, the degree of breakage has also been augmented in the Kunji assemblage by extensive thermal fracture. Many of the specimens (roughly 35% based on a partial artifact sample) have been burned, as evidenced by extensive cracking, crazing, and "potlidding" on the majority of heat-altered pieces (Table 1.4). These visibly damaged pieces also usually have smoother, more lustrous surfaces than unheated specimens (with some notable exceptions, however; see below). In addition, many of these burned flakes show severe thermal damage, both on the exterior (dorsal) and interior (ventral) surfaces, as well as along medial and lateral breaks.

A simple kiln experiment, using pieces of the reddish brown radiolarite, showed that comparable thermal damage could be replicated by rapidly heating specimens in an oxygen-rich environment. This same experiment, however, provided an unexpected result. Specimens of the same reddish brown radiolarite, when buried under a few centimeters of fine sand on the floor of the kiln so that they were not exposed directly to free-flowing air, showed no visible signs of crazing or "potlidding." Moreover, rather than becoming more lustrous as a result of the heat, they became dull and grayish white and actually took on a distinctly grainy texture almost like fine-grained quartzite. Many flakes nearly identical in appearance to these experimental specimens are present in the Kunji collection. The same experiment was not repeated using the green variety of radiolarite, although the results are likely to have been similar. The nature and distribution of thermal damage on the Kunji lithics, combined with the results from the kiln experiments, suggest that burning of the Mousterian chipped stone materials in the site was probably accidental, occurring when fires were kindled on an artifact-littered cave floor.

Thus, we believe that accidental burning as well as post-depositional processes, such as trampling by the cave's occupants, sediment compaction and downslope creep of the deposits, and repeated freezing and thawing, contributed significantly to the extent of artifact breakage in the Mousterian assemblage at Kunji. It is very likely, however, as we shall see below, that another primary source of the extensive breakage of tools also occurred during their manufacture, use, and modification.

TYPOLOGICAL AND TECHNOLOGICAL OBSERVATIONS

The Kunji collection is described in Table 1.5 using Bordes's (1961) traditional typology for Lower and Middle Paleolithic assemblages. These same data are summarized in a cumulative graph (real count) in Figure 1.10. Table 1.6 presents summary typological and technological indices associated with this typology (see Bordes 1972). Detailed metric data—including percussion and flake length, the angle between the two lengths, maximum width, distance between butt and maximum width, platform thickness, platform width, length/width ratio, and weight—are presented, for each of Bordes's sixty-three types and for broken tools and all other unretouched pieces (here defined as "Types 64 through 80"), in Table 1.7a-h. Information on the amount and distribution of cortex, again tabulated separately for each type, is given in Tables 1.8 (key) and 1.9a-h (tabulation). Finally, a sample of Kunji artifacts is illustrated in Figures 1.11-1.22.

Only tools recognized as "complete" are assigned to one of Bordes's sixty-three tool types in Tables 1.5, 1.7, and 1.9. For this purpose, "complete" retouched tools are those that show no breaks in the retouched edge, although they may, in fact, occur on less than complete flake blanks. The non-retouched "tools" in Bordes's typology (Levallois flakes, psuedo-Levallois flakes, and naturally backed knives) that are classified here are only those that are complete flakes. As the definitions of many of Bordes's types, particularly the scrapers and points, depend upon complete retouched edges, this conservative approach to the typology is intended to maximize reliability in the assignment of pieces to specific categories and to enhance comparability of the Kunji assemblage with assemblages from other sites.

At the same time, we are aware that if breakage occurs more often among certain tool types these will be underrepresented in our list. This

does not appear to be a significant factor in the description of the Kunji material, however, except perhaps in the calculation of the relative percentages of scrapers, as most broken pieces would appear to derive from some form of scraper or point. To facilitate comparison by other researchers who advocate or otherwise are compelled to include incomplete retouched tools in their type counts, we also provide the frequency and available metric data for flakes with broken scraperlike retouch (our Types 64 through 68) in Tables 1.5, 1.7, and 1.9 and our opinion on which major class of scrapers these most likely represent. We caution, however, that some or all of those tabulated as "double scrapers" may in fact be broken convergent scrapers; similarly, some or all of those tabulated as "convergent" broken pieces may in fact represent fragmentary Mousterian points (for a further discussion of the latter problem, see Holdaway 1989).

TOOL TYPOLOGY

Referring to the typological indices (Table 1.6) and the cumulative graph (Fig. 1.10), the basic characteristics of the Kunji assemblage are evident. Most notable among retouched pieces are the side-scrapers (racloirs: Types 9-29), with a calculated IR for the complete count of 58.8, and for the essential count, 71.9. To these we also add a "retouched" count, after Jelinek (1975:303-304), which also removes the unretouched naturally backed knives and pseudo-Levallois points from the total. The IR for this further restricted count of the collection is an impressive 77.5. Single side-scrapers, particularly convex-edged pieces, are the most common, followed by convergent, and then double, scrapers.

This predominance of side-scrapers in the Zagros Mousterian has long been recognized (Skinner 1965), in fact, even before these types were formally defined by Bordes (e.g., the frequency of "knives" described by Coon 1951). It has, moreover, been confirmed in more recent reanalyses (Dibble 1984a). Nonetheless, both Bewley (1985) and Akazawa (1975), in their analyses of collections from Houmian and Shanidar D, respectively, report relatively modest scraper indices for the Zagros Mousterian in their complete counts (Houmian: 33.9; Shanidar D: 24.7). Bewley's low figure appears to result from a combination of a small tool count and a high frequency of naturally backed knives and "miscellaneous" tools (i.e., "divers," Type 62). Akazawa, on the other hand, identified numerous marginally retouched pieces in the Shanidar material, as well as high frequencies of types not normally associated with the Zagros Mousterian: denticulates, notches, burins, and percoirs. We, along with others, have previously suggested that some of this variation results from different researchers' interpretations and applications of the typology, as well as from biases in the collections themselves (Dibble and Holdaway, this volume; see also Dibble 1984a:24; Dibble and Holdaway 1990).

After the scrapers, one notes that Mousterian points (normal and elongated) form a significant part of the Kunji collection. A total of sixty-one examples were identified among the complete retouched tools, including twenty-one that are elongated. More points are undoubtedly represented in the broken retouched pieces. We concur with Dibble (1984a:26), following Bordes (1961:27), that a restricted description of points is necessary if a distinction between these pieces and convergent scrapers is to be maintained. Specifically, the tip of a Mousterian point as defined should be pointed, or nearly pointed, in both its planar and lateral aspects. It is likely that a more liberal approach (e.g., Bewley 1985: Fig. 19) would augment the count of Mousterian points at Kunji with pieces classified here as convergent scrapers. Ultimately, however, the distinction may be moot, as more evidence is put forward that points and convergent scrapers form a continuum (Dibble 1988:186; see below, "Discussion"), and that the Zagros Mousterian "points" themselves may not have been hafted as projectiles (Holdaway 1989; for more general discussions concerning the function of Mousterian points, see also Beyries 1987; Roebroeks et al. 1988:21-22, and references therein). Pooled together as Bordes's Group II (Mousterian Group), the Mousterian points and scrapers at Kunji represent 65.8% of the complete typological count and 80.4% of the essential count. They account for 86.8% of our "retouched count."

A variety of types combine to make up the few remaining retouched pieces at Kunji. These include a small group of notches and denticulates, and a dozen typical and atypical percoirs, as well as some burins and truncations. Outnumbering all of these, however, are amorphous marginally retouched flakes (Types 45-50), whose presence and relationship to the scrapers should probably be given more consideration in future studies than has been done in the past, in light of recent discussions

of resharpening and continuous tool reduction (e.g., Barton 1990a, 1990b; Dibble 1984b, 1987a, 1987b, 1988; Rolland and Dibble 1990).

Finally, we note also the presence of the "truncated- faceted" retouch described recently by Dibble (1984a:29) for the Bisitun collection, but also identified by others in Paleolithic contexts both near to, and distant from, the Zagros (e.g., Schroeder 1969; Solecki and Solecki 1970; Crew 1976; Turq and Marcillaud 1976; Goren-Inbar 1988, 1990:117). Twenty-five pieces at Kunji exhibit edges with secondary, acute-edge modification created by the removal of small flakes from either a truncation (i.e., the classic form of "truncated-faceted") or another suitable platform along the flake margin (i.e., variants broadly resembling "truncated-faceted" pieces). Among the Kunji specimens, we include ten examples of inverse removal of the bulb of percussion, using the existing striking platform of the blank (see Coon 1951:57-65), and three pieces with exterior (dorsal) faceting from a natural break. As at Bisitun and also at Warwasi (see Dibble and Holdaway 1990), we find no consistent pattern to the occurrence of these modifications (Table 1.10). In only two cases is it the only retouch on the flake. It is also worth noting, however, that the edges of some of the pieces identified as cores in the assemblage are in many respects similar to this truncated- faceting. It remains an open question whether this represents a method of blank production (i.e., Nahr Ibrahim cores; see Solecki and Solecki 1970) or, instead, the modification of expired cores for subsequent use as tools.

TECHNOLOGY

Included as part of Bordes's traditional typological categories, the presence and frequency of Levallois flakes and naturally backed "knives" may best be discussed within the context of technology and core reduction. As noted earlier, naturally backed knives are relatively common at Kunji, even though the classic form (Type 38) comprises only between 5% and 6% of all the tool types classified according to the Bordes categories. These flakes, or more often elongated "flake-blades," with steep cortex along one edge, have previously been acknowledged as an integral part of the Zagros Mousterian (Skinner 1965; Akazawa 1975). As stated above, we must probably attribute this, at least in part, to the small, rounded, nodular form of the raw material source. The technology used to reduce these nodules, however, almost certainly also contributed to the extensive presence of naturally backed pieces, particularly when we consider the frequency with which these served as blanks for retouched tools. For example, among single scrapers for which these data were collected, one-third (94 of 294) are naturally backed or otherwise have some form of cortical edge opposite the worked side. We have not as yet compiled the data for the remainder of the tools, but it is possible to say that most other tool types also employed at least some cortical-edged blanks, particularly the marginally retouched pieces. Unfortunately, at the present stage of analysis we are unable to determine to what extent the frequency of these backed pieces in the Kunji assemblage reflects a deliberate core reduction strategy, largely independent of nodule form, with the production of these blanks as the intended goal (or perhaps the deliberate choice of cortical blanks from a broader suite of blank types at a knapping location elsewhere), or instead simply reflects the inherent proclivity of small, rounded, radiolarite nodules to yield this type of flake (see also below, "Discussion"). Clearly, more detailed analyses of the method(s) of core reduction at Kunji are needed to better evaluate these alternatives (see, e.g., Baumler 1988).

Less anticipated by most researchers may be the frequency with which Levallois flakes can also be identified in the Kunji assemblage. The typological Levallois index (ILty) for the collection is 7.6; the IL is 11.1, using as a sample all complete retouched and unretouched flakes greater than or equal to 3 cm in length. These figures by no means compare to the high values that were once believed to characterize the "classic" Levalloisian industries of the Levant (i.e., Skinner's "Group C" Mousterian). As more recent studies in the Levant are beginning to show, however, even there the real incidence of Levallois may be considerably lower than formerly thought, perhaps, in fact, not all that different from the levels seen at Kunji and elsewhere in the Zagros (see, e.g., Jelinek 1981; Meignen and Bar-Yosef 1988:83; and tabulated IL values in Goren-Inbar 1990:141-144). The Kunji data certainly add further confirmation to statements by Dibble (1984a) and Bewley (1985) that Skinner's (1965) and others' (e.g., Hole and Flannery 1967:155) assessment of the Zagros Mousterian as having negligible evidence of the Levallois "technique" may be overstated. We suspect that the Levallois index, in fact, would be even higher at Kunji were it not for the extensive

retouch that occurs in the assemblage, in many cases all but obliterating evidence of the original flake blank morphology. Employing a skeptical and cautious eye, we still identify 16% of all the blanks at Kunji used in Bordes's Types 1–63 as Levallois flakes or blades. Both unidirectionally and radially prepared Levallois flakes are represented, the latter outnumbering the former by approximately 2:1 in the unretouched sample.

Dibble (1984a:29-32) also makes a case for many more Levallois blanks than previously thought in the Bisitun tool assemblage, and provides likely explanations for the discrepancy between recent and past counts of Levallois indices in the Zagros Mousterian. We agree with him that over time researchers have taken Bordes's description of this so-called prepared core technology in many different directions, an understandable outcome given inherent ambiguities in the definition of the technique and the lack of universal or even mutually exclusive criteria for the recognition of its products (for recent discussions of the Levallois concept, see especially Boëda 1988, 1990).

In this respect, the presence of a certain frequency of typological Levallois flakes at Kunji (both radially and unidirectionally prepared) may not tell us as much as we might hope about the method(s) of core reduction responsible for the assemblage, or how these may compare to other Zagros or Levantine Middle Paleolithic industries. Similar flake forms, including classic Levallois flakes or blades, can be and were produced by very dissimilar methods of core reduction, not invariably apparent in the individual flakes or cores themselves (Marks and Volkman 1983; Volkman 1983; Baumler 1987, 1988; Boëda 1988, 1990). Thus, while we believe the Levallois flakes at Kunji fit the traditional and widely used definition of preparation and predetermination, as well as the morphological criteria in common use for the identification of the technique, we are reluctant to make comparative statements concerning other assemblages from these data alone.

Moreover, we are unsure at this point to what extent the presence of these Levallois flakes at Kunji can or should be taken to reflect the purpose in core reduction (see also Boëda 1988, 1990). If the utilized blanks (either formally retouched or edge-damaged) at the site are any measure of the intent of core reduction, then at least some of the cores may also have been prepared to produce naturally backed flakes or even "normal" flakes. Perhaps the strongest argument that can be made in support of the view that Levallois production at Kunji did, in fact, involve a discrete and deliberate reduction strategy stems from the small size of the raw material nodules that were available to the cave's Mousterian inhabitants. Most of these nodules were so small that it is hard to imagine the same piece being used simultaneously to produce both Levallois flakes and naturally backed flakes.

Although the Kunji flakes on the whole appear elongate, Bordes's laminar index (Ilam), in fact, is quite low (11.9) and "true" prismatic blades are very rare (two clearly intrusive "bladelets," made on unusual materials, have been excluded from consideration throughout this discussion). If we employ the maximum length of the flake (as most researchers do) rather than the length of the percussion axis (as advocated by Bordes), the Ilam is expectedly elevated, but not dramatically so, to just over 18 (see Table 1.6). Thus, although the Kunji flakes are generally longer than they are wide and mostly ovoid in shape, they do not approach the degree of laminarity recently described for the Bisitun (Dibble 1984a) or Warwasi (Dibble and Holdaway 1990) collections, each with an Ilam over 40. Excavator retention bias, of course, must be considered in any technological discussion of the latter two sites. However, along with the relatively smaller size of the Kunji flakes and flake tools, this difference may ultimately be a reflection of differences in the raw material available to these sites, or possibly in the techniques of core preparation and reduction. The published laminar indices for Houmian, Shanidar, and Hazar Merd, on the other hand, are consistent with the Kunji assemblage (Skinner 1965; Bewley 1985:19).

Platform "preparation" in the Kunji assemblage (Table 1.11; see also Table 1.6), when observable and recorded, ranges from none to extensive faceting (IF=72.1; IFs=22.8). Faceting as defined here refers to the presence of from one to as many as six small scars on the surface of the platform (generally oriented more or less perpendicular to the breadth of the platform), but does not necessarily imply that any or all of these facets were produced deliberately and explicitly to facilitate flake removal. At least some of these facets are likely to reflect the fortuitous traces of overlapping scars left by prior flake removals, and others are probably little more than damage resulting from the impact process itself. The use of

nodular raw material at Kunji is no doubt at least partly responsible for the presence of quite a few cortical platforms, which constitute approximately 5% of the sample and occur even on some Levallois flakes. Overall, the extent to which platforms are or are not faceted would not appear to relate to flake type. Small core-trimming flakes at Kunji exhibit more or less the same range and care of platform preparation as do Levallois flakes, naturally backed knives, or other tool blanks. Comparison of the flakes comprising Bordes's tool types with all other flakes reveals no significant differences in the percentages of faceted platforms (Types 1-68: IF=71.1 and IFs=24.0; Other flakes: IF=74.5 and IFs=19.5).

Interestingly, however, the degree of faceting on flake platforms does appear to be related to flake size. Several size attributes of complete flakes (retouched and unretouched combined) with no or few facets (0-2) differ significantly from those of complete flakes with multiple (3-6) facets, suggesting the presence of two distinct flake blank populations (Table 1.12). Although the absolute size differences between the two groups are very small and would probably not have been perceptible to the Mousterian flint-knappers themselves, the more highly faceted specimens are, on average, shorter, thinner, and lighter than the flakes with few or no facets. Very similar results are obtained when the size attributes of retouched and unretouched flakes are examined separately (data not shown). Based on insights from experimental fracture studies, in which steel balls were dropped from an electromagnet onto glass prisms of different volumes but identical platform angles (Speth 1981), these results might suggest that the more highly faceted specimens were derived from smaller cores, presumably ones that were significantly further along in the reduction sequence. This would support the notion, suggested above, that platform faceting in the Kunji assemblage may, at least to some extent, be the fortuitous cumulative by-product of numerous prior flake removals from cores rather than a form of deliberate platform preparation.

On the other hand, the amount of cortex on flakes in the two faceting groups does not pattern as might be expected. If extensively faceted flakes were, on average, produced later in the reduction sequence than those with few or no facets, one might expect there to be significantly less cortex on the flakes in the former group. This appears not to be the case. Both flake groups are dominated by specimens with no cortex (approximately 75% in each category), and in both groups slightly in excess of 20% of the flakes are partially cortical. Moreover, and perhaps counterintuitively, more of the flakes with extensive faceting still preserve traces of cortex on their platforms (17.1%, 55 of 321) than do flakes with little or no faceting (2.2%, 24 of 1,106). These results raise the possibility that the two flake populations are the products of different core reduction strategies rather than different stages within the same overall reduction process. It is interesting in this regard that a higher proportion of the flakes with little or no faceting are broken (58.6%, 648 of 1,106) than of those with more extensive faceting (45.8%, 147 of 321), despite the fact that the flakes in the former group are, on average, thicker, and presumably therefore more robust, than those in the latter group. Unfortunately, given the data at hand, we are unable to resolve the issue of whether these two flake blank populations represent different stages within the same overall reduction process or two distinct reduction strategies. Possible ways in the future of clarifying this issue further would be to compare the platform angles, exterior (dorsal) scar patterns (i.e., unidirectional versus radial), and proportion of cortically backed specimens in the two flake groups. Unfortunately, coding these data for an adequate sample of the Kunji assemblage would have greatly delayed completion of the present report and was therefore not undertaken.

DISCUSSION

If one theme underlies both the technology and the typology of this lithic assemblage from Kunji, it is the intensity of lithic reduction. Most aspects of the collection combine to portray an industry marked by an exhaustive use of raw material.

As described earlier (see Table 1.1), the proportion of retouched pieces in the total assemblage is very high (40% by frequency; 48% by weight) and far exceeds that of most published Middle Paleolithic assemblages, including the recognized implement-rich Charentian industries of Western Europe (see Rolland 1977, 1981, 1988; Rolland and Dibble 1990) and the Acheulo-Yabrudian of the Levant (Jelinek 1982; Copeland and Hours 1983). In Table 1.13 the frequency percentage is recalculated to exclude cores and all

pieces less than 3 cm in length, resulting in a figure for retouched pieces in the assemblage in excess of 60%. When we add to these formally retouched pieces those which exhibit macro-edge damage of the type that can be attributed with reasonable reliability to use-wear (e.g., Odell and Odell-Vereecken 1980), over 70% of the lithic sample from Kunji shows evidence of use or secondary modification.

Unlike most other published Zagros Middle Paleolithic collections, this high percentage of retouched and used pieces cannot be attributed to collector bias during excavation or to subsequent museum curation bias. Moreover, it is not likely to be an artifact of a small, non-representative excavation sample. Most of the Mousterian deposits in the cave's interior were sampled in the 1969 excavations. The only area of the site that was not sampled is the terrace in front of the cave. However, it is not even certain whether Mousterian deposits occur in this area, since much of the terrace fill may have been deposited there by the Iranian army when the interior of the cave was leveled to house munitions. Based on research elsewhere, it seems unlikely, though obviously not impossible, that unretouched pieces (and perhaps cores, as well) would be disproportionately more abundant on the terrace than inside the cave. Finally, we note that the previous excavations at Kunji by Hole and Flannery (1967:155) observed a similar high proportion of retouched tools to waste flakes.

The kinds of retouched pieces themselves also reflect the intensity of lithic reduction in the assemblage. Scrapers with regular retouch predominate over marginally retouched pieces, and tools with multiple worked edges (e.g., double and convergent scrapers, Mousterian points) are common. One means for measuring the intensity of secondary modification can be obtained through an alternative approach, advocated by Jelinek (1988:204), to Bordes's traditional typology of tools. According to this approach, retouched pieces in Bordes's type list are aggregated into four groups defined by the increasing extent or intensity of flaking, i.e., retouch by one or a few blows (Category 1), retouch limited to short or discontinuous edges (Category 2), extensive continuous retouch on one edge (Category 3), and extensive continuous retouch on multiple edges (Category 4). Table 1.14 provides the counts and percentages for each of these four groups at Kunji, clearly illustrating the degree to which extensively retouched pieces account for the majority of the collection. Nearly 90% of the tools considered in this tabulation fall within Categories 3 and 4; almost 40% are in Category 4 alone, the most extensively retouched.

The intensive use of lithic material exhibited by the tools is also evident in the technology of flake production. We have already noted the exhausted appearance of the cores, whose average weight (32.05 g) is only four times that of the average flake (8.15 g; see Tables 1.7h and 1.3, respectively). The number of retouched flakes relative to cores is also quite high with a ratio of 32:1, based on complete specimens only. This obvious scarcity of cores is striking, and becomes all the more so in light of the small size of the original cobbles from which the flakes presumably were removed. This disparity between the number of cores and retouched flakes may suggest that many of the tool blanks (or the finished tools themselves) were produced elsewhere and then transported to the cave (assuming of course that cores are equally rare on the terrace).

The apparent underrepresentation of cores relative to retouched pieces at Kunji may also be enhanced, however, by the fact that the site's Mousterian inhabitants made use of virtually the entire spectrum of blank types that came off their cores for the production of retouched tools, including partially cortical, naturally backed, Levallois, and a variety of "normal" flakes. An important question, of course, is whether this range of blank types represents the products of two or more distinct reduction strategies at Kunji, one unidirectional, the other radial, or a single reduction strategy designed to maximize both the early and late production of suitable tool blanks within the constraints of the size and shape of the raw material available for use. Thus, it is possible that we are dealing with a shift, during a single reduction process, from unidirectional to radial (or "centripetal") platform use as the mass of the core decreased. A similar core reduction/blank production strategy has recently been reconstructed by one of us for the Middle Paleolithic of northern Bosnia (Baumler 1987, 1988). In both the Kunji and northern Bosnian industries, one finds remarkably similar exhausted, radially prepared disc cores in conjunction with both single-platform-struck (unidirectional) "flake-blades" and radially prepared flakes, the former blanks being, on average, larger than the latter (Table 1.15). Both industries also employed a significant proportion of

naturally backed flakes as blanks for tools. Finally, the possibility of a technological/stylistic tradition notwithstanding, it is perhaps no coincidence that radiolarite nodules were also used in the northern Bosnian Middle Paleolithic.

However, even these seemingly similar technological approaches to lithic raw material do not begin to anticipate the degree to which lithic material was put to use at Kunji. In the Kunji collection, both cortical and non-cortical, large and small, and complete as well as broken flakes were employed as tool blanks. The acceptance of such a broad range of usable forms would suggest that the occupants of Kunji had need to, or at least chose to, conserve lithic raw material.

SCRAPER TYPOLOGY AND REDUCTION

Given the intensity of reduction evident in the Kunji assemblage and the prevalence of its scrapers, it is appropriate to consider recent discussions implicating resharpening as a major cause of variability in Middle Paleolithic scraper morphology. In an important and stimulating series of articles, Dibble (e.g., 1984b, 1987a, 1987b, 1988) has developed arguments to suggest that the various major forms of Middle Paleolithic scrapers (i.e., single, double, and convergent) are likely to represent stages in the use-life of the same basic tool (see also Barton 1990a, 1990b). The different morphologies, he has reasoned, are a predictable result of the rejuvenation of a retouched edge in conjunction with the retouching of additional edge(s) as needed during the use of the tool. Initially derived from a study of the Bisitun collection, Dibble has since applied the scraper "resharpening model," with variations, as an interpretative paradigm for Middle Paleolithic tool assemblages in general (Rolland and Dibble 1990).

Many aspects of the Kunji collection support the notion that the different types of scrapers are related rather than being discrete functional or stylistic forms. In some important respects, however, the data from Kunji are neither consistent with that from Bisitun nor necessarily indicative of resharpening as an explanation, suggesting that the model may be in need of further refinement or perhaps is not universally applicable.

A major expectation of Dibble's scraper reduction model for Bisitun is that scraper size will diminish through reduction as retouch intensity increases. More specifically, if single, double, and convergent scrapers represent a continuum, then they should exhibit evidence of a common origin from which there follows a sequence of increasing removal of material in a direct and progressive fashion. Tables 1.16 and 1.17 present relevant data, respectively, on specimen size and "retouch intensity" (i.e., the degree of invasiveness of the retouch scars, as defined by Dibble 1984b:433; see also Kuhn 1990 for a different measure) for the complete Kunji scrapers. When possible, these same tables also present comparative data for the Bisitun scrapers as published by Dibble (1984a, 1984b).

As at Bisitun, the three major types of scrapers at Kunji show an increasing intensity of retouch, albeit with a narrower range of variability and more apparent overlap among the scraper classes than at Bisitun. This is, nonetheless, consistent with and strong evidence in support of the reduction model.

However, in contrast to Bisitun, to the extent that thickness most accurately reflects the size of the unreduced original blank, there is evidence at Kunji that at least the single and double scrapers derive from different initial populations of flake blanks (platform thickness: single vs. double scraper, $t=2.012$, $df=289$, $P=0.045$). It should be pointed out, however, that platform thickness, the only measure of specimen thickness recorded for the entire assemblage of scrapers at Kunji, may not be an ideal proxy for the thickness of the body of the flake below the bulb of percussion, the measure employed by Dibble at Bisitun (although in experimental fracture studies, the two thickness measures are very highly correlated; see Speth 1981:17).

Platform width, another possible, though less reliable, proxy for the size of the original flake blank, also differs significantly, in this case between single and convergent scrapers ($t=-2.835$, $df=261$, $P=0.005$), and between double and convergent scrapers ($t=-2.345$, $df=121$, $P=0.021$), with the convergents having the widest platforms.

Finally, platform area (approximated by multiplying platform thickness by platform width) also points toward the use of different blank populations for the manufacture of double and convergent scrapers, the latter having a significantly larger mean value ($t=2.714$, $df=118$, $P=0.008$).

Also inconsistent with Bisitun, the single side-scrapers at Kunji are not, as would be predicted

by the scraper reduction model, significantly longer than the convergent scrapers (percussion axis length: t=0.785, df=278, P=0.433; maximum flake axis length: t=0.915, df=391, P=0.361), nor, in fact, do they differ significantly in length from the double scrapers (percussion axis length: t=-1.532, df=273, P=0.127; maximum flake axis length: t=-1.539, df=375, P=0.125). This apparent lack of significant difference in the lengths of the various scrapers has also been observed for at least one other Zagros Mousterian assemblage, that from Warwasi (Dibble and Holdaway 1990).

The above metric observations on the size of the Kunji scrapers do not conform very closely to the expectations of the original reduction model developed by Dibble for Bisitun. We note, however, that in a more recent study of the scrapers from the French Mousterian site of La Quina, Dibble (1987a, 1987b) has revised his model somewhat, arguing that larger blanks may commonly undergo more reduction than smaller ones and, therefore, one should not necessarily assume that a single uniformly sized blank population was used among all scraper types in an assemblage. This may also be true of blank shape, since Dibble (1987c, n.d.) notes that shape is largely responsible for the differences between the resharpening sequences that he has reconstructed for the French Quina Mousterian and the Zagros Middle Paleolithic (see also Barton 1990a, 1990b).

Such differences in original blank size and shape could explain the lack of predicted patterning in the Kunji scraper metric data. However, if it is possible, and even expected, that original blank form and/or size will be different among the three classes of scrapers (see also Kuhn 1992), then we must question the reliability, and the relevance in the first place, of metric and non-metric data collected from the single and double scrapers to describe and represent the early stages of a reduction and resharpening sequence leading to convergent scrapers.

Estimates of the degree of blank reduction provided by comparing the surface area of the scrapers with their platform area are an effort to address more directly resharpening and avoid, perhaps, the methodological paradox surrounding the use of the linear dimensions of discarded single and double scrapers to represent the early stages of scraper reduction (Dibble 1987a, 1987b; Dibble and Holdaway 1990). Aside from questions of the ability of platform area to accurately predict flake size (see Kuhn 1992), this approach when applied to the Kunji data also fails to provide unambiguous support for the scraper resharpening model. Based on the ratio of surface area to platform area (see Table 1.16), single scrapers at Kunji do not differ significantly from either double scrapers (t=-0.621, df=259, P=0.535) or convergent scrapers (t=1.081, df=257, P=0.281). In other words, convergent and double scraper blanks do not appear, as predicted by the model, to be more reduced than single scraper blanks. The only difference in this ratio that approaches statistical significance—and one that would conform to the predictions of the scraper reduction model—is between double and convergent scrapers (t=1.773, df=118, P=0.079).

Much of the difference between Bisitun and Kunji, and the lack of congruence of the Kunji material with a continuous scraper reduction model, appears to lie with the single side-scrapers. At Kunji, these scrapers appear on the whole to be unlikely preforms (and, therefore, inappropriate early reduction stage models) for the double and convergent scrapers. They are too small and otherwise exhibit characteristics peculiar to themselves. For example, nearly half (47%) of the single scrapers have some cortical surfaces, and often, as observed earlier, this is in the form of fairly steep cortical backing along one of the edges (32%) that would be difficult to retouch. When the opposing edge of single scrapers is non-cortical, it is frequently a break or other steep edge greater than forty-five degrees (27%) that would also be difficult to retouch. All in all, these are not the type of blank one would expect to be transformed by further reduction into the double and convergent scrapers at Kunji.

Interestingly, in this regard, when we examine the retouch intensity of the "backed" single side-scrapers at Kunji (i.e., those with steep natural backing, or moderately steep cortical opposing edges, or non-cortical opposing edges—particularly those formed by breaks—that are greater than or equal to 45 degrees) separately from the specimens with "normal" opposing edges (i.e., those with non-cortical edges that are less than 45 degrees), significant variability is revealed (Table 1.18). Those single scrapers that are most unlikely to be transformed into double and convergent scrapers (i.e., those with steep opposing edges) exhibit the greatest retouch intensity. This is most strikingly seen in the true naturally backed specimens. The presence of these heavily retouched backed scrapers

certainly must contribute to the greater overall similarity in retouch intensity between single and convergent scrapers at Kunji than was observed by Dibble between these scraper classes at Bisitun. On the other hand, if we exclude these steeply backed single side-scrapers and consider just the metric attributes of those with "normal" opposing edges, this smaller sample of Kunji scrapers still remains inconsistent with the predictions of the reduction model, though less strikingly so. In essence, all but one of the size attributes of the "normal" single scrapers are statistically indistinguishable from those of the double and convergent scrapers. The only exception is mean width, which as predicted by the model is significantly less in convergent scrapers than in "normal" single scrapers ($t=2.436$, $df=216$, $P=0.016$). In sum, while the heterogeneity within the single side-scrapers can be viewed as evidence of preferential resharpening of blanks with backing, this observation adds little support to the general scraper reduction model.

Any understanding of scraper reduction must ultimately consider why and when scrapers were reduced and discarded. At Kunji, there is reason to believe that discard of the various scraper classes was related in some way to mass, inasmuch as the average weight is remarkably consistent across the various scraper classes (see Table 1.16; single vs. double scraper, $t=0.060$, $df=375$, $P=0.952$; single vs. convergent scraper, $t=1.076$, $df=391$, $P=0.283$; double vs. convergent scraper, $t=0.817$, $df=180$, $P=0.415$). Length or width alone may also be determining factors as these too, with only one exception (the maximum length of double vs. convergent scrapers), are not significantly different across the scraper classes (maximum flake axis length: single vs. double scraper, $t=-1.539$, $df=375$, $P=0.125$; single vs. convergent scraper, $t=0.915$, $df=391$, $P=0.361$; double vs. convergent scraper, $t=1.941$, $df=180$, $P=0.054$; maximum width: single vs. double scraper, $t=-0.280$, $df=375$, $P=0.779$; single vs. convergent scraper, $t=1.010$, $df=391$, $P=0.313$; double vs. convergent scraper, $t=1.116$, $df=180$, $P=0.266$).

Dibble's (1984a) suggestion, therefore, that scraper width is the primary cause of discard at Bisitun is not ruled out, and is perhaps supported by the Kunji data. It is interesting in this regard that the widths of the discarded Kunji scrapers are closely comparable to those from Bisitun, despite the fact that the average length and overall size of the scraper classes from the two sites are quite different. Whether this possible norm represents a minimum width beyond which further reduction was not possible (Dibble 1984b) or, alternatively, a preferred dimension in the manufacture of scrapers (regardless of type) beyond which further reduction was not considered necessary or desirable is less readily apparent (e.g., if width were constrained in some way by the requirements of prehension or hafting).

This last notion, that the scrapers at Kunji may somehow be intentionally the way they are, and more than arbitrary points along a continuum of reduction, underlies our ambivalence toward resharpening as the sole driving force in scraper morphology. Despite the many incongruities in the Kunji data, we are fully prepared to accept that resharpening, along with concomitant changes in tool morphology and perhaps function (i.e., the "Frison effect"; see Jelinek 1976; Frison 1968), does in fact operate within and among the sixty-one retouched types defined by Bordes, and particularly among the sixteen major types of side-scrapers (Dibble 1988). It seems to us that resharpening within a class of scrapers is particularly likely, as, say, among the single side-scrapers described above or between Mousterian "points" and convergent scrapers (see below).

However, we are less certain how this progressive retouch and transformation of tool morphology over the use-life of an implement is to be properly distinguished from the deliberate one-time manufacture of a multiple-edged or heavily retouched tool. To what extent can we, after the fact and on the basis of the discarded tools alone, successfully identify the intentional manufacture of a convergent scraper in a single knapping event, by retouching one side and then immediately retouching the second side so that it converges with the first one, from a convergent scraper created by a sequence of temporally discrete resharpening events that began with a single side-scraper, then was later reworked to form a double side-scraper, and then was finally resharpened to form a convergent scraper?

Both processes, retouch by manufacture and retouch by resharpening, would seem to us to result in comparable reductions in overall blank size and also in similar increases in retouch intensity. If this is in fact the case—that there is equifinality—then these two criteria do not provide unambiguous support for the "resharpening model" in Near Eastern and European Middle Paleolithic assemblages. Other arguments, for example, that the

edge angles of the different scraper types form a continuum (Dibble 1984b), or that these edge angles correlate independently with various measures of reduction (Dibble 1987b:40), do not necessarily clarify this situation. These data may merely confirm the fact that Middle Paleolithic tool types are variable, with attributes that overlap and are related to processes of reduction used to manufacture them, not necessarily to resharpen them.

In sum, there is no question that there is extensive lithic reduction exhibited in the scrapers discarded at Kunji, and particularly in the convergent scrapers. The question, however, remains for us to determine when and how this retouch is to be equated with resharpening. At present, with the data available, we cannot say to what extent scraper morphology and retouch at Kunji reflect deliberate manufacturing or the cumulative outcome of subsequent resharpening events. The issue is clearly an interesting and important one; the evidence, unfortunately, is equivocal. Other explanations for the presence of extensive retouch on a tool, perhaps unrelated to resharpening and reuse, must continue to be considered—for example, the different edge requirements of cutting and non-cutting tools, or the degree to which secondary modification and shaping are necessitated by variability in blank form (and modulated by the ability of Middle Paleolithic hominids systematically to control blank production). More direct information on the retouching process is also clearly needed to clarify this issue. In particular, we need to focus more attention on the small-sized chipping debris in Middle Paleolithic sites, specifically on the long-neglected microflakes generated by the manufacture and resharpening of tools by retouch. Through detailed use-wear studies designed to help identify the remnants of tool edges preserved on the platforms of microflakes, together with systematic attempts to refit these tiny chips to the actual specimens from which they were removed (see Frison 1968), we may eventually be able to delineate more clearly the relative roles played by resharpening—both within and between tool classes—and deliberate manufacture in determining the morphology of Middle Paleolithic tools (see also Dibble 1987a:115). Such studies will obviously require new techniques of field recovery, as well as the further development of appropriate methodologies (see Baumler and Downum 1989).

CONVERGENT SCRAPERS AND MOUSTERIAN POINTS

That there is a recognized overlap in the morphology of many of the tool types defined by Bordes has already been addressed in the discussion above and earlier in this chapter. Nowhere is this more apparent perhaps than in the attempt to separate the triangular or elongated specimens with converging retouch along both lateral edges into Mousterian points (Types 6-7) and convergent scrapers (Types 18-20). Traditionally, convergent scrapers have been distinguished from points by several subjective characteristics, among the more important of which are a less symmetrical overall shape, a thicker butt, body, and tip, a broader tip angle, and a less defined point.

In analyzing the Kunji collection, we have followed tradition in distinguishing these classic Mousterian tool forms, but we have also examined the extent to which these categories are metrically discrete or arbitrary breaks in what is really a continuum of variability (see also Dibble 1988). To do this, we measured the thickness of the tip of all points and convergent scrapers, arbitrarily but consistently selecting for measurement a point one-third of the distance along a line from the tip to the point of percussion (i.e., along the maximum flake length axis). We also measured the "sharpness" of the tips of the specimens by determining the angle formed by two lines from the tip that are tangent to the lateral edges of the specimens at the point on each side where a line drawn perpendicular to the flake axis, and through the locus where tip thickness was measured, intersects the lateral edges. These two measurements, together with the angle formed between the percussion and flake axes, provide reasonable indices of the thickness, sharpness, and overall symmetry of the specimens (Table 1.19). Additionally, a subjective measure of retouch intensity was also recorded for points, employing the same categories that we used earlier for the various scraper types (see Table 1.17).

Perhaps not unexpectedly, all three of the metric measures are essentially normally distributed with very little skewness or kurtosis. Moreover, when the combined distributions for points and convergents are examined, the three measures again show no tendency toward bimodality, skewness, or kurtosis that would suggest the presence of discrete categories.

Considering first the angle between the percussion and flake axes (i.e., a measure of the overall symmetry of the artifacts), both points and convergents have nearly identical mean values (-3.53 ±14.43 degrees and +0.37 ±11.68 degrees, respectively). A perfectly symmetrical flake, one in which the percussion and flake axes are identical, has an angle value of zero. When the interior or ventral surface of the flake is viewed with the platform toward the observer, a minus value indicates that the flake axis or maximum length is to the left of the percussion axis and a plus value that the flake axis is to the right. The data above indicate that points and convergents tend to be more or less equally symmetrical (t=-1.550, df=106, P=0.124).

The mean angles of the tip (i.e., the "sharpness") of points and convergent scrapers are also virtually identical (57.07 ±11.77 degrees and 55.82 ±10.53 degrees, respectively; t=0.594, df=111, P=0.554).

One metric attribute that does clearly distinguish the two types is the thickness of the tip. The tips of the points at Kunji are on the average thinner than those of convergent scrapers (0.45 ±0.11 cm and 0.55 ±0.18 cm, respectively; t=-3.538, df=111, P=0.0006). Average flake length and overall specimen weight are also greater in convergent scrapers than in Mousterian points (maximum length: t=-2.224, df=144, P=0.028; weight: t=-3.490, df=144, P=0.0006). Clearly, therefore, in typing these specimens, we tended to give priority to the thickness of the tip as well as to overall tool size, rather than to shape attributes such as broadness or "sharpness" of the tip or overall tool symmetry.

But these same attributes for the combined sample of points and convergents are nonetheless all normally distributed, with no evidence of bimodality, little skewness, and a slight tendency toward leptokurtosis, or, in other words, a tendency for values to be compressed somewhat toward the mean. This is the reverse of what one would expect if two distinct populations (i.e, points and convergent scrapers) were actually represented. It would seem that in classifying specimens we placed those which were distinctly heavier and with thicker tips in the convergent category and those which were lighter and with more delicate tips in the point category, but that the breakpoint between the two groups was, in fact, entirely arbitrary.

Other potentially relevant metric attributes that might be used to separate points and convergent scrapers also show little or no evidence for the presence of discrete categories. For example, if points were hafted but convergents were not, we might expect platform thickness in the former to be less than in the latter. This is not the case. The mean platform thickness for points is 0.52 ±0.17 cm; for convergent scrapers the value is 0.50 ±0.22 cm (t=0.613, df=107, P=0.541). Similarly, if points were employed as hafted projectiles, their maximum width might be expected to be smaller on the average than that of the convergent scrapers, and perhaps also less variable. This again, however, is not the case. The maximum width of points averages 2.49 ±0.53 cm; in convergents the mean value is 2.48 ±0.56 cm (t=0.179, df=144, P=0.858; F=1.097, df=84/60, P=0.355).

Two other criteria might be considered for distinguishing points from convergent scrapers. The first is the amount of cortex remaining on the flake. In specimens we classified as points, only 8% have traces of cortex, whereas among convergent scrapers the figure is 20%. However, this attribute certainly does not provide a clear-cut criterion for discriminating between the two tool categories, because in both types the vast majority of specimens have no remaining cortex. The difference may simply reflect the larger average size of the flake blanks used for "convergent scrapers."

The other measure is retouch intensity. Pieces that we classified as Mousterian points exhibit significantly less intensity of retouch than those we classified as convergent scrapers (see Table 1.17). Although once more this criterion is not exclusive, it is important perhaps with respect to the discussion above concerning scraper reduction. In our analysis, we excluded the points from the sample of convergent scrapers, consistent with previous discussion on the subject of the scraper reduction model (Dibble 1984b, 1987a, 1987b, 1988). It is readily apparent, however, that the merging of these seemingly similar tool types at Kunji would have at least some effect on the evidence put forward in support of the reduction model, specifically in the description of the degree of retouch on converging tools in contrast to that on single and double scrapers. Whether this is an argument to continue to exclude points from the reduction histories of the remainder of the scrapers or another element of the model in need of future reconsideration remains to be assessed.

CONCLUSIONS

Perhaps the most striking feature of the Kunji lithic assemblage is the intensity with which flakes, seemingly with little or no regard to initial blank type, have been utilized. This intensity is shown both by the technology of flake production and by the overall typological composition of the assemblage, including the sheer abundance of retouched pieces. There is little lithic material in the collection that can be classified as intentional waste, perhaps even less if we were able to identify all the pieces that had actually been utilized. Based on similarities in the dimensions of the scrapers, the most common retouched tools represented at the site, the majority of the tools were discarded at Kunji because they had reached, either through their initial manufacture and use or by rejuvenation, the end of their functional utility.

How many of these discarded tools and blanks were brought to the cave or manufactured in place is not known for certain. However, given the notable scarcity of both cores and decortication flakes at Kunji, as well as the lack of "debris" (as defined above) otherwise anticipated in core reduction (Sullivan and Rozen 1985; Magne 1985; Baumler and Downum 1989; Prentiss and Romanski 1989), it seems very likely that many of the artifacts were, in fact, carried in from elsewhere, perhaps from other sites in the area, perhaps from manufacturing areas at suitable cobble sources. Although our very cursory raw material surveys in the Khorramabad Valley seemed to suggest that workable radiolarite cobbles would have been available relatively close at hand, the striking intensity of lithic utilization, as well as the scarcity of cores, at Kunji makes us question this (for particularly interesting discussions of the relationship among raw material availability, transport distance, and retouch intensity, see Geneste 1985, 1989; Roebroeks et al. 1988).

Not all initial core preparation and reduction was done away from the cave, however. Because a complete collection is available for study, we can say with confidence that at least some early stage nodule reduction did occur at the site. We can also provide confirmation that the extensive retouch that characterizes this and, by implication, other Zagros Mousterian assemblages is not entirely an artifact of excavation recovery or retention policies.

Although the publication of these data should prove useful for future comparative research, interpreting the Kunji collection beyond this point at this time is premature. The collection presented here is a relatively small and possibly biased sample, one derived entirely from the interior of the cave that may or may not be representative of the site as a whole. We do not know, in fact, to what extent the characteristics we have identified are those of a single part of a larger occupation or perhaps a palimpsest of many different uses of this location. We do know that it represents only a portion of a thicker and broader Mousterian horizon at Kunji and that this has been disturbed by extensive burrowing, though fortunately not mixed with later (or earlier) components.

It is, nonetheless, evident from data presented both recently and in the past that other Middle Paleolithic assemblages recovered from the Zagros, including the material from the previous excavations at Kunji itself (Hole and Flannery 1967), share many aspects of the collection described here. Included are similarities in raw materials, core reduction technology, retouched tool morphology, and other facets, both qualitative and quantitative, of the assemblage (see also Dibble and Holdaway 1990). Skinner's (1965) notion of a "Zagros Mousterian" as a recognizable entity within this region and distinct from other Near Eastern assemblages—particularly those of the Levant—has been widely used for many years and is not seriously challenged by the Kunji data reported here. This of course still acknowledges that its defining characteristics are justifiably the subject of continuing discussion and refinement, most particularly with respect to the putatively low frequency of Levallois products in Zagros sites in contrast to their supposedly much higher incidence in Levantine sites (Dibble 1984a; Bewley 1985; Goren-Inbar 1990; Meignen and Bar-Yosef 1988).

The degree of typological, if not also technological, homogeneity within and among the Zagros Mousterian assemblages is striking, and appears to exist despite the large region encompassed by this entity, the differences between sites in elevation and in micro- and macro-environmental settings, and the long temporal spans

that may be involved. Explaining these similarities, however, is no simple matter, and one that is far beyond the essentially descriptive goals of the present paper. For at the heart of this issue lies the fascinating but complex and unresolved debate concerning the nature of variability in Middle Paleolithic (and other) stone tool assemblages, and in particular the degree to which the observed variability is a reflection of style, function, technology, or raw material constraints (e.g., Barton 1990a, 1990b; Binford and Binford 1966; Bordes 1967; Jelinek 1976, 1988; Mellars 1970; Rolland and Dibble 1990; Speth 1988).

Is the apparent homogeneity in Zagros Mousterian stone tool assemblages evidence of a single, region-wide "paleo-population" or "paleo-tradition"? A "paleo-technology" constrained perhaps by the form and small size of the available radiolarite cobbles? A narrow or highly uniform set of "paleo-subsistence activities or strategies"? Or merely a "paleo-inability" to do much else with the basic cognitive or manual skills at hand? Clearly, understanding the nature and underlying causes of Mousterian assemblage variability remains one of the most fascinating and challenging problems in Paleolithic archaeology, for in tackling this issue we are probing the very "humanness" of the last premodern members of our lineage (e.g., Dibble and Montet-White 1988; Mellars and Stringer 1989; Trinkaus 1989). We know that the present paper will shed little new light directly on the theoretical side of this important issue; our goal here has been much more modest. What we do hope to have provided is a reasonable description and initial interpretation of a new set of quantitative data on the nature of variability in a single Middle Paleolithic assemblage from an as yet poorly known region of the world, data that can further the development of new models or be used to evaluate existing ones.

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TABLE 1.1. Kunji Cave Lithic Assemblage Composition (All Sizes).

	Complete		Broken		Total Frequency		Total Weight	
	N	(%)	N	(%)	N	(%)	gm	(%)
Ret. Flake	766	(47.9)	285	(27.4)	1051	(39.9)	9155.6	(48.1)
Unret. Flakes								
Cortical	36	(2.3)	2	(0.2)	38	(1.5)	—	—
Part. Cort.	272	(17.0)	135	(13.0)	407	(15.4)	—	—
Non-Cort.	500	(31.3)	440	(42.3)	940	(35.6)	—	—
Subtotal	808	(50.6)	577	(55.5)	1385	(52.5)	8083.3	(42.5)
Debris	—	—	156	(15.0)	156	(5.9)	697.3	(3.7)
Cores	24	(1.5)	21	(2.0)	45	(1.7)	1080.4	(5.7)
Total	1598		1039		2637		19,016.6	

Not included: 2 post-Mousterian intrusives; 74 Mousterian pieces not available for reanalysis are excluded from frequency counts but are included in weight calculations.

TABLE 1.2. Frequency of Limestone Flakes in Kunji Cave Assemblage.

Artifact Type	Type No. (see Table 7a-h)	N	(%)
Single Concave Scraper	11	1	2.5
Naturally Backed Knife	38	1	2.5
Notch	42	1	2.5
Broken Double Scraper	65	1	2.5
Complete Unret. Flake (Non-Cort.)	69	9	22.5
Complete Unret. Flake (Part. Cort.)	71	10	25.0
Complete Unret. Flake (Cortical)	73	4	10.0
Broken Unret. Flake	75	11	27.5
Debris	77	2	5.0
Total		40	100.0

Sample selection: Coding for lithic raw material type was completed for first 1500 items only (i.e., item numbers 1-1500).

TABLE 1.3 Metric Attributes of Complete Flakes Only in Kunji Cave Assemblage

Attribute[1]	Total Flake Sample[2]		Retouched Flakes Only[3]		Unretouched Flakes Only[4]	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	1092	3.45±1.09	518	3.67±0.93	514	3.18±1.19
Flake Len.	1092	3.94±1.17	518	4.34±0.93	514	3.51±1.26
Angle	1092	0.70±16.47	518	0.17±16.12	514	1.29±16.98
Max. Wid.	1092	2.49±0.69	518	2.62±0.60	514	2.35±0.74
Dist. Wid.	1092	1.67±0.90	518	1.86±0.90	514	1.47±0.84
Plat. Thick.	1084	0.44±0.22	514	0.50±0.21	510	0.38±0.22
Weight	1092	8.15±6.67	518	9.73±6.49	514	6.54±6.41
Plat. Width	966	1.52±0.70	462	1.60±0.65	447	1.44±0.73
Len./Wid.	1092	1.64±0.49	518	1.73±0.50	514	1.52±0.45

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.
[2]Includes all complete flakes (retouched, utilized, or showing no signs of use or modification).
[3]Includes only complete retouched flakes (specimens with edge utilization excluded).
[4]Includes only complete unretouched flakes (specimens with edge utilization excluded).

TABLE 1.4. Frequency and Distribution of Thermal Damage on Kunji Cave Artifacts.

Presence and Placement of Thermal Damage	N	(%)
Unburned	229	(64.5)
Burned exterior only	9	(2.5)
Burned interior only	15	(4.2)
Burned both sides	102	(28.7)
Total	355	(99.9)

Sample selection: Coding for presence and placement of thermal damage was completed for 355 of first 375 specimens only (i.e., item numbers 1-375).

TABLE 1.5. Typology of Kunji Cave Assemblage According to Bordes's Traditional 63 Tool Categories.

Type	N	Real%	Cum%	Ess%	Cum%
1. Typical Levallois Flake	26	2.93	2.93		
2. Atypical Levallois Flake	38	4.29	7.22		
3. Levallois Point	3	0.34	7.56		
4. Retouched Levallois Point	2	0.23	7.79	0.28	0.28
5. Pseudo-Levallois Point	5	0.56	8.35	0.69	0.97
6. Mousterian Point	40	4.51	12.86	5.52	6.49
7. Elongated Mousterian Point	21	2.37	15.23	2.90	8.39
8. Limace	1	0.11	15.34	0.14	9.53
9. Single Straight SS	101	11.40	26.74	13.93	23.46
10. Single Convex SS	166	18.74	45.48	22.90	46.36
11. Single Concave SS	27	3.05	48.53	3.72	50.08
12. Double Straight SS	16	1.81	50.34	2.21	52.29
13. Double Straight/Convex SS	28	3.16	53.50	3.86	56.15
14. Double Straight/Concave SS	2	0.23	53.73	0.28	56.43
15. Double Convex SS	21	2.37	56.10	2.90	59.33
16. Double Concave SS	2	0.23	56.33	0.28	59.56
17. Double Convex/Concave SS	14	1.58	57.91	1.93	61.49
18. Convergent Straight SS	21	2.37	60.28	2.90	64.39
19. Convergent Convex SS	50	5.64	65.92	6.90	71.29
20. Convergent Concave SS	14	1.58	67.50	1.93	73.22
21. Dejete SS	14	1.58	69.08	1.93	75.15
22. Transverse Straight SS	12	1.35	70.43	1.66	76.81
23. Transverse Convex SS	18	2.03	72.46	2.48	79.29
24. Transverse Concave SS	2	0.23	72.69	0.28	79.57
25. Interior SS	3	0.34	73.03	0.41	79.98
26. Steep SS	3	0.34	73.37	0.41	80.39
27. Thin-backed SS	-	-	73.37	-	80.39
28. Bifacial SS	-	-	73.37	-	80.39
29. Alternate SS	7	0.79	74.16	0.97	81.36
30. Typical End Scraper	6	0.68	74.84	0.83	82.19
31. Atypical End Scraper	2	0.23	75.07	0.28	82.47
32. Burin	3	0.34	75.41	0.41	82.88
33. Atypical Burin	2	0.23	75.64	0.28	83.16
34. Piercer	10	1.13	76.77	1.38	84.54
35. Atypical Piercer	7	0.79	77.56	0.97	85.51
36. Backed Knife	3	0.34	77.90	0.41	85.92
37. Atypical Backed Knife	5	0.56	78.46	0.69	86.61
38. Naturally Backed Knife	48	5.42	83.88	6.62	93.23
39. Raclette	4	0.45	84.33	0.55	93.78
40. Truncation	7	0.79	85.12	0.97	94.75
41. Tranchet	-	-	85.12	-	94.75
42. Notches	11	1.24	86.36	1.52	96.27
43. Denticulates	19	2.14	88.50	2.62	98.89
44. Bec Burin	-	-	88.50	-	98.89
45. Retouched Flake - Interior	14	1.58	90.08		
46. Retouched Flake - Steep	-	-	90.08		
47. Retouched Flake - Steep/Alt	-	-	90.08		
48. Retouched Flake - Light	73	8.24	98.32		
49. Retouched Flake - Light/Alt	3	0.34	98.66		

Table 1.5 (cont.)

50. Retouched Flake - Bifacial	4	0.45	99.11		
51. Tayac Point	-	-	99.11	-	98.89
52. Triangular Notch	-	-	99.11	-	98.89
53. Psuedo Microburin	-	-	99.11	-	98.89
54. End-Notched Flake	5	0.56	99.67	0.69	99.58
55. Hachoir	-	-	99.67	-	99.58
56. Rabot	-	-	99.67	-	99.58
57. Stemmed Point	-	-	99.67	-	99.58
58. Stemmed Tool	-	-	99.67	-	99.58
59. Chopper	-	-	99.67	-	99.58
60. Unifacial Chopper	-	-	99.67	-	99.58
61. Chopping Tool	-	-	99.67	-	99.58
62. Miscellaneous	3	0.33	100.00	0.42	100.00
63. Bifacial Point	-	-	100.00	-	100.00
Total	886				
64. Broken Scraper (Single?)	80	28.07			
65. Broken Scraper (Double?)	74	25.96			
66. Broken Scraper (Convergent?)	30	10.53			
67. Broken Scraper (Cnvg. Tip)	31	10.88			
68. Broken Scraper (Unknown)	70	24.56			
Total	285				

TABLE 1.6. Summary Typological and Technological Indices of Kunji Cave Assemblage.

	Complete Count (886)	Essential Count (725)	Retouched Count (672)
Typological			
ILty	7.6		
IR	58.8	71.9	77.5
IQ	2.7	2.7	2.7
IAu	0.9	1.1	1.2
Group I (Lev)	7.8		
Group II (Moust)	65.8	80.4	86.8
Group III (UPaleo)	4.4	5.4	5.8
Group IV (Dent)	2.1	2.6	2.8
Technological			
IL (≥3cm):	11.1		
IF:	72.1		
IFs:	22.8		
Ilam1	11.9		
Ilam2	18.2		
Unretouched Levallois/All Unretouched Flakes:			8.9
Unretouched Levallois/Unretouched Flakes ≥3cm:			13.0
Levallois Flakes/Types 1-63:			16.0

Indices after Bordes (1972)

Typological indices based on complete tools/flakes only.
Complete count: Types 1-63
Essential count: Types 4-44, 51-63
Retouched count: Types 4, 6-37, 39-44, 51-63 (after Jelinek 1975)

Ilam[1] (Laminar index): Percussion length ≥ Twice maximum width
Ilam[2] (Laminar index): Maximum length ≥ Twice maximum width

TABLE 1.7a Metric Attributes of Kunji Cave Assemblage by Bordes' Types (1-7)

Attribute[1]	Total Sample[2]		Bordes' Type													
			(1) Typical Levallois Flake		(2) Atypical Levallois Flake		(3) Levallois Point		(4) Retouched Levallois Point		(5) Pseudo Levallois Point		(6) Mousterian Point		(7) Elongated Mousterian Point	
	N	Mean±1σ	N	Mean±1σ	N	Mean±1σ	N	Mean±1σ	N	Mean±1σ	N	Mean±1σ	N	Mean±1σ	N	Mean±1σ
Perc. Len.	1283	3.45±1.06	23	4.03±0.77	30	3.98±1.06	3	4.03±1.23	2	4.20±0.14	5	2.86±0.88	33	3.02±0.67	18	3.92±1.00
Flake Len.	2661	3.51±1.20	26	4.30±1.03	38	4.39±1.06	3	4.57±1.17	2	4.60±0.71	5	3.50±0.67	40	3.77±0.62	21	4.88±0.69
Angle	1283	0.43±16.30	23	1.96±13.54	30	4.87±13.25	3	-8.00±8.00	2	-4.00±5.66	5	-1.00±19.51	33	-2.27±15.94	18	-5.83±11.21
Max. Width	2661	2.37±0.73	26	2.92±0.49	38	2.97±0.57	3	3.27±0.12	2	2.80±0.42	5	2.56±0.55	40	2.59±0.56	21	2.30±0.44
Dist. Wid.	1421	1.65±0.87	22	1.80±0.68	31	1.94±0.78	3	0.90±0.36	2	0.95±0.35	5	1.12±0.28	33	1.12±0.39	18	1.55±0.77
Plat. Thick.	1677	0.44±0.22	24	0.43±0.15	32	0.47±0.21	3	0.43±0.18	2	0.50±--	4	0.60±0.28	35	0.52±0.18	18	0.52±0.14
Weight	2643	7.22±6.79	26	8.09±5.38	38	9.57±5.80	3	9.65±5.04	2	8.07±2.71	5	4.55±2.32	40	6.67±3.38	21	7.56±3.27
Plat. Width	1386	1.54±0.70	24	2.06±0.59	30	1.96±0.68	3	2.64±0.59	2	1.96±1.03	3	2.33±1.01	32	1.83±0.60	18	1.49±0.38
Len./Wid.	2661	1.55±0.53	26	1.48±0.30	38	1.51±0.40	3	1.39±0.30	2	1.64±0.00+	5	1.39±0.27	40	1.49±0.23	21	2.15±0.25

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

[2]Total sample from 1969 excavations was 2713 specimens, including 2637 assignable to Bordes' type, 74 partly analyzed but untyped specimens that were lost over the intervening 20 years since the excavation, and 2 clearly intrusive non-Mousterian specimens.

TABLE 1.7b Metric Attributes of Kunji Cave Assemblage by Bordes' Types (8-15)

Attribute[1]	Bordes' Type															
	(8) Limace		(9) Simple Straight Racloir		(10) Simple Convex Racloir		(11) Simple Concave Racloir		(12) Double Straight Racloir		(13) Double Str.-Convex Racloir		(14) Double Str.-Concv. Racloir		(15) Double Biconvex Racloir	
	N	Mean±1σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	-	----	67	3.72±0.74	122	3.82±0.86	20	3.82±1.40	12	4.37±0.98	23	4.10±0.92	2	3.55±0.21	16	4.13±1.01
Flake Len.	1	4.00±--	101	4.50±0.80	166	4.42±0.83	27	4.77±1.13	16	4.75±0.93	28	4.86±0.86	2	4.20±0.71	21	4.60±0.88
Angle	-	----	67	-2.37±15.22	122	-2.03±13.10	20	11.40±15.48	12	0.25±8.27	23	-3.30±13.51	2	3.00±16.97	16	-1.13±11.95
Max. Width	1	1.30±--	101	2.53±0.55	166	2.70±0.63	27	2.48±0.61	16	2.56±0.44	28	2.72±0.57	2	2.45±0.49	21	2.74±0.53
Dist. Wid.	-	----	68	1.94±0.92	123	2.02±0.86	20	2.37±1.29	12	2.21±1.15	24	2.23±1.23	2	1.65±1.63	17	2.36±1.16
Plat. Thick.	-	----	71	0.54±0.22	132	0.52±0.22	21	0.50±0.23	11	0.43±0.12	24	0.51±0.19	2	0.40±--	17	0.48±0.17
Weight	1	3.31±--	101	10.19±4.65	166	10.57±5.80	27	10.16±5.43	16	9.24±3.72	28	11.69±5.25	2	6.14±0.19	21	11.27±5.69
Plat. Width	-	----	70	1.54±0.62	114	1.64±0.65	18	1.46±0.56	11	1.64±0.79	23	1.63±0.60	2	2.18±0.82	14	1.44±0.53
Len./Wid.	1	3.08±--	101	1.85±0.52	166	1.70±0.42	27	2.02±0.58	16	1.89±0.44	28	1.86±0.49	2	1.78±0.65	21	1.74±0.46

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.7c Metric Attributes of Kunji Cave Assemblage by Bordes' Types (16-23)

Attribute'	Bordes' Type															
	(16) Double Biconcave Racloir		(17) Double Cnvx.-Cncv. Racloir		(18) Straight Convergent Racloir		(19) Convex Convergent Racloir		(20) Concave Convergent Racloir		(21) Dejete Racloir		(22) Straight Transverse Racloir		(23) Convex Transverse Racloir	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	1	3.10±--	12	3.33±0.89	13	3.82±0.98	34	3.86±0.81	10	3.71±0.62	14	3.17±0.92	11	2.55±0.41	15	2.98±0.65
Flake Len.	2	4.60±1.27	14	4.21±0.54	21	4.41±0.70	50	4.44±0.97	14	4.67±0.71	14	3.88±1.09	12	3.46±0.73	18	3.48±0.88
Angle	1	7.00±--	12	11.92±19.11	13	1.31±8.88	34	0.71±12.71	10	-2.00±11.98	14	9.71±22.32	11	4.55±32.44	15	-3.27±29.71
Max. Width	2	2.70±0.28	14	2.46±0.42	21	2.68±0.57	50	2.48±0.55	14	2.16±0.46	14	3.01±0.47	12	3.14±0.62	18	3.46±0.71
Dist. Wid.	1	1.70±--	12	1.91±1.01	13	1.33±0.51	34	1.51±0.62	10	1.53±0.52	14	1.59±0.68	11	1.64±0.47	15	1.61±0.53
Plat. Thick.	1	0.15±--	12	0.43±0.21	14	0.49±0.17	33	0.51±0.24	9	0.45±0.20	13	0.61±0.20	11	0.50±0.21	15	0.56±0.28
Weight	2	13.45±8.12	14	7.79±2.93	21	9.93±4.26	50	10.17±6.06	14	7.40±2.63	14	10.17±6.55	12	7.10±2.95	18	9.54±5.56
Plat. Width	1	2.47±--	11	1.37±0.52	14	1.97±0.79	27	1.91±0.65	9	1.40±0.63	11	1.96±0.75	8	1.67±0.43	12	2.23±1.10
Len./Wid.	2	1.74±0.65	14	1.77±0.46	21	1.72±0.51	50	1.86±0.53	14	2.23±0.48	14	1.30±0.31	12	1.17±0.50	18	1.03±0.27

'Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.7d Metric Attributes of Kunji Cave Assemblage by Bordes' Types (24-33)

Attribute[1]	Bordes' Type																	
	(24) Concave Transverse Racloir		(25) Racloir Ventral Surface		(26) Abruptly Retouched Racloir		(29) Alternate Retouched Racloir		(30) Typical Endscraper		(31) Atypical Endscraper		(32) Typical Burin		(33) Atypical Burin	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	2	2.65±1.20	1	3.00±--	3	4.13±1.10	5	3.38±0.49	5	3.78±1.27	2	4.45±1.48	1	2.90±--	1	3.10±--
Flake Len.	2	3.85±1.48	3	3.27±0.74	3	5.40±0.53	7	4.06±0.58	6	4.18±0.97	2	5.00±1.13	3	5.63±1.19	2	3.50±0.14
Angle	2	-32.00±12.73	1	0.00±--	3	-5.00±13.23	5	-3.40±15.29	5	-2.60±15.29	2	-16.00±14.14	1	26.00±--	1	16.00±--
Max. Width	2	3.55±0.64	3	3.27±0.25	3	2.27±0.45	7	2.53±0.45	6	2.47±0.54	2	2.25±0.35	3	2.43±0.47	2	2.15±0.21
Dist. Wid.	2	1.50±--	1	2.00±--	3	2.30±1.18	5	1.44±0.71	5	2.30±1.27	2	2.90±1.13	-	----	1	0.90±--
Plat. Thick.	2	0.45±0.07	1	0.50±--	3	0.21±0.28	4	0.55±0.13	5	0.28±0.16	2	0.41±0.01	1	0.46±--	1	0.60±--
Weight	2	8.76±8.27	3	10.04±6.36	3	14.67±9.63	7	8.49±3.85	6	10.14±4.68	2	14.75±11.41	3	12.16±3.79	2	6.80±1.58
Plat. Width	2	2.22±1.12	-	----	2	1.40±--	4	1.67±0.12	3	1.23±0.26	2	1.15±0.33	-	----	1	1.87±--
Len./Wid.	2	1.06±0.23	3	1.00±0.18	3	2.42±0.31	7	1.64±0.35	6	1.82±0.82	2	2.21±0.16	3	2.33±0.32	2	1.63±0.10

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.7e Metric Attributes of Kunji Cave Assemblage by Bordes' Types (34-42)

Attribute[1]	Bordes' Type																	
	(34) Typical Percoir		(35) Atypical Percoir		(36) Typical Backed Knife		(37) Atypical Backed Knife		(38) Naturally Backed Knife		(39) Raclette		(40) Truncation		(42) Notch	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	9	3.20±0.47	6	3.15±0.76	1	2.40±--	3	4.17±1.51	42	3.85±0.95	2	3.35±0.21	1	3.50±--	5	3.90±1.37
Flake Len.	10	4.28±0.88	7	3.60±0.74	3	3.60±0.69	5	4.02±1.12	48	4.32±0.80	4	3.50±0.70	7	3.41±0.75	11	3.86±1.26
Angle	9	4.44±14.93	6	5.33±18.37	1	20.00±--	3	1.67±11.59	42	-3.24±15.31	2	18.50±4.95	1	0.00±--	5	8.80±14.41
Max. Width	10	2.43±0.55	7	2.69±0.41	3	1.87±0.42	5	2.10±0.42	48	2.28±0.59	4	2.15±0.79	7	2.31±0.38	11	2.57±0.66
Dist. Wid.	9	1.64±0.63	5	1.52±1.00	1	1.10±--	3	1.77±0.31	42	1.96±0.88	2	2.00±0.42	2	1.85±0.21	6	2.02±0.65
Plat. Thick.	9	0.41±0.19	6	0.39±0.19	1	0.40±--	3	0.38±0.16	45	0.47±0.22	2	0.33±0.39	3	0.48±0.18	6	0.39±0.23
Weight	10	6.77±3.14	7	7.46±4.15	3	4.35±2.52	5	5.41±1.84	48	9.14±6.94	4	4.82±4.40	7	5.69±2.36	11	9.50±7.10
Plat. Width	9	1.48±0.80	5	1.64±0.55	1	1.45±--	3	1.17±0.53	39	1.28±0.51	2	1.34±1.11	2	1.26±--	6	1.39±0.78
Len./Wid.	10	1.81±0.44	7	1.37±0.35	3	1.98±0.46	5	2.01±0.84	48	1.99±0.54	4	1.75±0.52	7	1.51±0.40	11	1.58±0.59

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.7f Metric Attributes of Kunji Cave Assemblage by Bordes' Types (43-64)

Attribute[1]	Bordes' Type															
	(43) Dentic.		(45) Interior Retouched Flake		(48) Marginally Retouched Piece		(49) Marginally Retouched Piece		(50) Bifacially Retouched Piece		(54) End-Notched Flake		(62) Divers		(64) Broken Scraper Simple	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	8	3.50±0.97	6	4.08±0.37	52	3.77±0.96	1	3.60±--	2	2.95±0.35	2	3.65±0.49	-	----	19	2.84±0.56
Flake Len.	19	3.87±0.79	14	4.06±0.69	73	4.08±0.98	3	4.73±0.75	4	3.95±0.87	5	3.94±0.81	3	3.47±0.75	80	3.07±0.73
Angle	8	7.50±26.31	6	5.00±18.13	52	2.23±15.46	1	-7.00±--	2	13.50±2.12	2	0.00±--	-	----	19	3.68±20.93
Max. Width	19	2.74±0.66	14	2.91±0.61	73	2.67±0.66	3	3.43±1.07	4	3.18±0.57	5	2.98±0.54	3	2.60±0.56	80	2.54±0.59
Dist. Wid.	11	1.82±0.64	7	2.13±0.39	56	1.95±0.93	1	1.70±--	2	1.00±0.57	2	1.60±0.71	-	----	34	1.76±0.69
Plat. Thick.	9	0.57±0.14	9	0.49±0.17	59	0.46±0.18	1	0.60±--	3	0.87±0.87	3	0.57±0.12	-	----	51	0.57±0.25
Weight	19	12.11±17.33	14	11.37±5.56	73	9.23±5.43	3	26.80±19.27	4	16.62±7.23	5	13.48±8.80	3	8.63±4.24	80	6.96±3.75
Plat. Width	9	1.84±0.89	7	1.67±0.63	51	1.67±0.80	1	1.64±--	3	2.51±0.36	3	1.94±0.48	-	----	44	1.72±0.67
Len./Wid.	19	1.52±0.58	14	1.43±0.27	73	1.59±0.43	3	1.45±0.34	4	1.27±0.39	5	1.35±0.35	3	1.33±0.10	80	1.27±0.40

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.7g Metric Attributes of Kunji Cave Assemblage by Bordes' Types (65-72)

Attribute[1]	Bordes' Type															
	(65) Broken Scraper Double		(66) Broken Scraper Conver.(?)		(67) Broken Scraper Convergent Tip		(68) Broken Scraper Fragment		(69) Unretouched Flake Complete Non-Cort.		(70) Unretouched Flake Complete Non-Cort. Utilized		(71) Unretouched Flake Complete Part Cort.		(72) Unretouched Flake Complete Part Cort. Utilized	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	16	3.26±0.64	17	3.32±0.78	--	----	3	2.03±0.35	312	2.92±1.12	37	3.54±0.73	164	3.42±1.16	25	4.08±0.87
Flake Len.	74	3.24±0.91	30	3.77±0.84	31	2.80±0.74	70	2.65±0.73	386	3.13±1.16	42	3.87±0.78	196	3.80±1.21	28	4.34±0.88
Angle	16	-0.19±12.89	17	-6.71±12.11	--	----	3	-8.00±21.79	312	0.02±17.24	37	0.30±16.12	164	1.95±16.79	25	0.88±11.49
Max. Width	74	2.42±0.55	30	2.38±0.52	31	2.20±0.65	70	1.90±0.55	386	2.17±0.72	42	2.44±0.68	196	2.43±0.66	28	2.51±0.68
Dist. Wid.	33	1.62±0.77	20	1.33±0.53	1	1.90±--	3	1.23±0.32	325	1.32±0.77	38	1.62±0.72	167	1.66±0.90	27	1.81±1.02
Plat. Thick.	45	0.45±0.17	21	0.49±0.20	1	0.10±--	11	0.51±0.06	335	0.37±0.22	39	0.45±0.23	170	0.37±0.21	27	0.41±0.17
Weight	74	6.88±4.00	30	7.13±3.62	31	3.90±3.26	70	3.62±2.14	386	4.75±4.57	42	6.08±3.92	196	7.94±7.00	28	9.01±7.52
Plat. Width	40	1.56±0.66	20	1.62±0.76	--	----	1	1.00±--	296	1.37±0.70	36	1.40±0.81	139	1.31±0.64	26	1.39±0.62
Len./Wid.	74	1.40±0.51	30	1.68±0.57	31	1.34±0.39	70	1.49±0.54	386	1.48±0.47	42	1.69±0.51	196	1.60±0.48	28	1.82±0.49

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.7h Metric Attributes of Kunji Cave Assemblage by Bordes' Types (73-80)

Attribute[1]	Bordes' Type															
	(73) Unretouched Flake Complete Cortical		(74) Unretouched Flake Broken Utilized		(75) Unretouched Flake Broken		(76) Unretouched Flake Broken Lev.(?)		(77) Debris		(78) Core Complete		(79) Core Broken		(80) Pebble Non-local	
	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ	N	Mean±1 σ
Perc. Len.	20	3.39±1.19	7	3.81±0.91	15	3.23±1.03	1	3.00±--	---	----	--	----	--	----	-	----
Flake Len.	36	3.70±1.25	52	3.40±1.26	511	2.78±0.96	14	3.25±0.75	156	2.41±1.08	24	4.38±0.59	21	3.89±0.62	1	5.50±--
Angle	20	5.60±18.89	7	1.00±19.57	15	-3.60±13.64	1	20.00±--	---	----	--	----	--	----	-	----
Max. Width	36	2.73±0.92	52	2.28±0.62	511	2.14±0.64	14	3.14±0.78	156	1.68±0.84	24	3.75±0.57	21	2.84±0.62	1	2.80±--
Dist. Wid.	22	1.51±0.92	13	1.99±1.33	59	1.43±0.73	1	1.80±--	---	----	--	----	--	----	-	----
Plat. Thick.	23	0.34±0.23	23	0.44±0.17	211	0.40±0.23	9	0.45±0.15	---	----	--	----	--	----	-	----
Weight	36	12.16±11.83	52	6.81±6.75	511	4.38±3.90	14	6.53±3.47	156	4.47±8.53	24	32.05±15.11	21	14.82±10.08	1	35.96±--
Plat. Width	19	1.51±0.83	19	1.48±0.66	127	1.52±0.64	7	1.90±0.86	---	----	--	----	--	----	-	----
Len./Wid.	36	1.41±0.44	52	1.56±0.59	511	1.37±0.49	14	1.09±0.33	156	1.59±0.71	24	1.18±0.10	21	1.39±0.18	1	1.96±--

[1]Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake (maximum length of specimen, regardless of orientation, for flakes lacking striking platform or for miscellaneous debris); Angle, in degrees between percussion axis and flake axis, measured on ventral face (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width, measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thick. (Platform Thickness), measured on striking platform from ventral to dorsal face (perpendicular to ventral); Weight, maximum weight of specimen; Plat. Width (Platform Width), measured at ventral face; Len./Wid. (Length/Width Ratio), utilizing maximum length of flake axis and maximum width of flake, as defined above.

TABLE 1.8. Key to Cortex Amount and Placement Codes Used in Table 1.9a-h for Kunji Cave Artifacts.

Explanation of Cortex Codes		
Cortex Code	Amount of Cortex on Platform	Amount of Cortex on Body
Yes/Yes	Partially to completely	> 75%
Yes/Prt.	Partially to completely	25% < X < 75%
Yes/No	Partially to completely	None
No/Yes	None	> 75%
No/Prt.	None	25% < X < 75%
No/No	None	None
No/Trc.	None	< 25%
?/Prt.	Platform missing	25% < X < 75%
?/Yes	Platform missing	>75%

TABLE 1.9a Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (1-7)

Cortex Placement and Amount Plat./Body[1]	Total Sample		Bordes' Type						
	N	%	(1) Typical Levallois Flake N	(2) Atypical Levallois Flake N	(3) Levallois Point N	(4) Retouched Levallois Point N	(5) Pseudo Levallois Point N	(6) Mousterian Point N	(7) Elongated Mousterian Point N
Yes/Yes	30	1.11	-	-	-	-	-	-	-
Yes/Prt.	34	1.25	-	-	-	-	-	-	-
Yes/No	50	1.84	-	4	-	-	-	2	-
No/Yes	21	0.77	-	-	-	-	-	-	-
No/Prt.	300	11.07	1	-	-	-	-	-	1
No/No	1887	69.61	23	33	3	2	4	37	19
No/Trc.	225	8.30	2	1	-	-	-	1	1
?/Prt.	140	5.16	-	-	-	-	-	-	-
?/Yes	24	0.89	-	-	-	-	1	-	-
Total with Cortex	824	30.4	3	5	-	-	1	3	2
Total without Cortex	1887	69.6	23	33	3	2	4	37	19

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9b Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (8-15)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(8) Limace N	(9) Simple Straight Racloir N	(10) Simple Convex Racloir N	(11) Simple Concave Racloir N	(12) Double Straight Racloir N	(13) Double Str.-Convex Racloir N	(14) Double Str.-Concv. Racloir N	(15) Double Biconvex Racloir N
Yes/Yes	-	6	1	-	-	-	-	-
Yes/Prt.	-	4	7	1	-	-	-	-
Yes/No	-	4	5	-	-	1	-	1
No/Yes	-	-	2	-	-	-	-	-
No/Prt.	-	22	37	5	5	1	-	2
No/No	1	38	90	16	10	24	2	16
No/Trc.	-	11	9	2	1	2	-	2
?/Prt.	-	14	14	3	-	-	-	-
?/Yes	-	2	1	-	-	-	-	-
Total with Cortex	-	63	76	11	6	4	-	5
Total without Cortex	1	38	90	16	10	24	2	16

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9c Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (16-23)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(16) Double Biconcave Racloir N	(17) Double Cnvx.-Cncv. Racloir N	(18) Straight Convergent Racloir N	(19) Convex Convergent Racloir N	(20) Concave Convergent Racloir N	(21) Dejete Racloir N	(22) Straight Transverse Racloir N	(23) Convex Transverse Racloir N
Yes/Yes	-	-	-	-	-	-	-	-
Yes/Prt.	-	-	-	-	-	-	-	-
Yes/No	-	-	1	-	-	1	-	1
No/Yes	-	-	-	-	-	-	-	-
No/Prt.	1	2	3	2	1	1	1	-
No/No	1	8	11	45	12	11	8	15
No/Trc.	-	3	5	3	1	1	3	2
?/Prt.	-	1	1	-	-	-	-	-
?/Yes	-	-	-	-	-	-	-	-
Total with Cortex	1	6	10	5	2	3	4	3
Total without Cortex	1	8	11	45	12	11	8	15

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9d Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (24-33)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(24) Concave Transverse Racloir N	(25) Racloir Ventral Surface N	(26) Abruptly Retouched Racloir N	(29) Alternate Retouched Racloir N	(30) Typical Endscraper N	(31) Atypical Endscraper N	(32) Typical Burin N	(33) Atypical Burin N
Yes/Yes	-	-	-	-	-	-	-	-
Yes/Prt.	-	-	1	1	-	-	-	-
Yes/No	-	-	-	1	-	-	-	-
No/Yes	-	-	-	-	-	-	-	-
No/Prt.	1	-	1	-	3	-	-	-
No/No	1	3	1	5	2	2	2	2
No/Trc.	-	-	-	-	1	-	1	-
?/Prt.	-	-	-	-	-	-	-	-
?/Yes	-	-	-	-	-	-	-	-
Total with Cortex	1	-	2	2	4	-	1	-
Total without Cortex	1	3	1	5	2	2	2	2

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9e Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (34-42)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(34) Typical Percoir N	(35) Atypical Percoir N	(36) Typical Backed Knife N	(37) Atypical Backed Knife N	(38) Naturally Backed Knife N	(39) Raclette N	(40) Truncation N	(42) Notch N
Yes/Yes	-	-	-	-	-	-	-	-
Yes/Prt.	-	-	-	-	4	-	-	-
Yes/No	-	-	-	-	-	-	-	1
No/Yes	-	-	-	-	-	-	-	-
No/Part.	-	1	-	1	35	1	-	1
No/No	6	5	3	3	-	3	6	8
No/Trc.	4	1	-	1	8	-	1	-
?/Prt.	-	-	-	-	1	-	-	1
?/Yes	-	-	-	-	-	-	-	-
Total with Cortex	4	2	-	2	48	1	1	3
Total without Cortex	6	5	3	3	-	3	6	8

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9f Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (43-64)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(43) Dentic. N	(45) Interior Retouched Flake N	(48) Marginally Retouched Piece N	(49) Marginally Retouched Piece N	(50) Bifacially Retouched Piece N	(54) End-Notched Flake N	(62) Divers N	(64) Broken Scraper Simple N
Yes/Yes	-	1	-	-	-	-	-	-
Yes/Prt.	1	-	1	-	-	-	-	1
Yes/No	-	-	2	-	-	-	-	-
No/Yes	-	-	-	-	-	-	-	-
No/Prt.	-	3	12	-	1	-	-	10
No/No	16	6	46	1	2	5	-	56
No/Trc.	1	3	9	-	-	-	-	4
?/Prt.	1	1	2	2	1	-	-	9
?/Yes	-	-	-	1	-	-	-	-
Total with Cortex	3	8	27	2	2	-	-	24
Total without Cortex	16	6	46	1	2	5	-	56

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9g Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (65-72)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(65) Broken Scraper Double N	(66) Broken Scraper Conver.(?) N	(67) Broken Scraper Convergent Tip N	(68) Broken Scraper Fragment N	(69) Unretouched Flake Complete Non-Cort. N	(70) Unretouched Flake Complete Non-Cort. Utilized N	(71) Unretouched Flake Complete Part Cort. N	(72) Unretouched Flake Complete Part Cort. Utilized N
Yes/Yes	-	1	-	-	-	-	2	-
Yes/Prt.	-	-	-	-	-	-	4	-
Yes/No	2	-	-	-	1	-	20	-
No/Yes	-	1	-	-	-	-	1	-
No/Prt.	5	2	-	-	-	1	93	13
No/No	58	22	30	67	385	41	2	-
No/Trc.	2	2	-	2	-	-	73	15
?/Prt.	7	2	1	-	-	-	-	-
?/Yes	-	-	-	1	-	-	1	-
Total with Cortex	16	8	1	3	1	1	194	28
Total without Cortex	58	22	30	67	385	41	2	-

[1] See Table 1.8 for key to cortex codes.

TABLE 1.9h Amount of Cortex on Kunji Cave Artifacts by Bordes' Types (73-80)

Cortex Placement and Amount Plat./Body[1]	Bordes' Type							
	(73) Unretouched Flake Complete Cortical N	(74) Unretouched Flake Broken Utilized N	(75) Unretouched Flake Broken N	(76) Unretouched Flake Broken Lev.(?) N	(77) Debris N	(78) Core Complete N	(79) Core Broken N	(80) Pebble Non-local N
Yes/Yes	17	-	2	-	-	-	-	-
Yes/Prt.	-	-	9	-	-	-	-	-
Yes/No	-	-	3	-	-	-	-	-
No/Yes	13	1	3	-	-	-	-	-
No/Prt.	-	4	27	-	-	-	-	-
No/No	-	34	392	14	134	7	12	-
No/Trc.	-	7	40	-	-	-	-	-
?/Prt.	-	6	28	-	19	17	9	-
?/Yes	6	-	7	-	3	-	-	1
Total with Cortex	36	18	119	-	22	17	9	1
Total without Cortex	-	34	392	14	134	7	12	-

[1] See Table 1.8 for key to cortex codes.

TABLE 1.10. "Truncated-Faceted" Pieces in Kunji Cave Assemblage.

Artifact Class	Truncated-Faceted		Exterior (Dorsal) Faceting from Break		Inverse Bulb Removal		Total	
	N	(%)	N	(%)	N	(%)	N	(%)
Unretouched	2	(16.7)	-	—	-	—	2	(8.0)
Single Scraper	1	(8.3)	-	—	4	(40.0)	5	(20.0)
Double Scraper	2	(16.7)	1	(33.3)	2	(20.0)	5	(20.0)
Convergent Scraper	5	(41.7)	-	—	2	(20.0)	7	(28.0)
Mousterian Point	-	—	-	—	2	(20.0)	2	(8.0)
Denticulate	2	(16.7)	-	—	-	—	2	(8.0)
Other Tools	-	—	2	(66.7)	-	—	2	(8.0)
Total	12		3		10		25	

For discussion of "truncated-faceted" pieces, see Dibble (1984a) and Goren-Inbar (1988).

TABLE 1.11. Frequency of Faceted Platforms in Kunji Cave Assemblage.

ALL SPECIMENS (Types 1-80; see Table 1.7a-h for type list).

Number of Facets	N	(%)
0 (plain)	395	27.9
1	400	28.3
2 (dihedral)	298	21.1
3	72	5.1
4	79	5.6
5	73	5.2
6	97	6.9
Total	1414	100.1

BORDES TOOL TYPES ONLY (Types 1-68: see Table 1.7a-h for type list)

Number of Facets	N	(%)
0 (plain)	293	28.9
1	264	26.0
2 (dihedral)	214	21.1
3	60	5.9
4	70	6.9
5	54	5.3
6	59	5.8
Total	1014	99.9

NON-BORDES TOOL TYPES ONLY (Types 69-80; see Table 1.7a-h for type list)

Number of Facets	N	(%)
0 (plain)	102	25.5
1	136	34.0
2 (dihedral)	84	21.0
3	12	3.0
4	9	2.3
5	19	4.8
6	38	9.5
Total	400	100.1

Sample selection: Coding for platform faceting was completed for 1414 of first 1500 specimens only (i.e., item numbers 1-1500).

TABLE 1.12. Comparison of Metric Attributes of Complete Flakes from Kunji Cave with Low (0-2) and High (3-6) Numbers of Platform Facets.

	Facet No. (0-2)			Facet No. (3-6)		
Attribute	N	Mean	S.D.	N	Mean	S.D.
Perc. Len.	458	3.86	0.96	174	3.73	0.98
Flake Len.	458	4.45	0.98 *	174	4.28	0.94
Angle	458	0.46	16.46	174	0.07	15.86
Max. Wid.	458	2.70	0.63	174	2.63	0.56
Dist. Wid.	458	1.87	0.93	174	1.77	0.87
Plat. Thk.	458	0.50	0.20 ***	174	0.44	0.21
Weight	458	10.22	6.07 **	174	8.90	5.96
Plat. Wid.	414	1.60	0.67	155	1.66	0.69
Len./Wid.	458	1.72	0.48	174	1.69	0.50
Surf./Plat.	414	21.37	19.65 *	155	25.67	27.26

Sample selection: Coding for platform faceting was completed for 1414 of first 1500 specimens only (i.e., item numbers 1-1500).

Significant t-tests of differences between means of metric attributes for flakes with low (0-2) and high (3-6) numbers of platform facets denoted by asterisks (* = $P < 0.05$; ** = $P < 0.01$; *** = $P < 0.001$).

Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake; Angle, in degrees, between percussion axis and flake axis, measured on interior (ventral) face with bulbar end toward observer (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Width (Maximum Width), measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thk. (Platform Thickness), measured on striking platform at point of impact from interior (ventral) to exterior (dorsal) face (perpendicular to interior); Weight, maximum weight of specimen; Plat. Wid. (Platform Width), measured at interior (ventral) face; Len./Wid. (Length/Width Ratio), using maximum flake axis length; Surf./Plat. (Surface Area/Platform Area Ratio), where surface area is maximum flake length times maximum width, and platform area is platform width times platform thickness.

TABLE 1.13. Frequency of Retouched and Unretouched Flakes in Kunji Cave Assemblage.

	All Flakes		Flakes with Length ≥3 cm only	
	N	(%)	N	(%)
Retouched Flakes	1051	(40.5)	831	(61.1)
Edge-Damaged Flakes (Use?)	150	(5.8)	134	(9.8)
Unmodified Flakes	1235	(47.6)	379	(27.9)
Debris	156	(6.1)	17	(1.2)
Total	2592	(100.0)	1361	(100.0)

TABLE 1.14. Reduction Intensity of Kunji Cave Retouched Tool Assemblage (after Jelinek 1988).

Reduction Intensity	N	(%)
Category 1	40	(6.0)
Category 2	35	(5.2)
Category 3	340	(50.8)
Category 4	254	(38.0)
Total	669	(100.0)

Not included: 3 miscellaneous retouched pieces (Type 62)

Category 1: Bordes's Types 32-33, 42-44, 52-54
Category 2: Bordes's Types 4, 34-35, 37, 39-41, 57-58
Category 3: Bordes's Types 9-11, 22-25, 30-31, 36, 55
Category 4: Bordes's Types 6-8, 12-21, 26-29, 60, 63

TABLE 1.15. Metric Attributes for Kunji Cave Unretouched Complete Non-Cortical Flakes with Radial and Unidirectional Exterior (Dorsal) Flake-Scar Patterns.

	Radial			Unidirectional		
Attribute	N	Mean	S.D.	N	Mean	S.D.
Perc. Len.	47	3.44	0.81	49	4.07	1.06
Flake Len.	54	3.62	0.82	54	4.44	1.05
Angle	47	2.30	15.68	49	0.98	13.17
Max. Wid.	54	2.77	0.47	54	2.49	0.64
Dist. Wid.	49	1.53	0.66	48	1.76	0.90
Plat. Thk.	50	0.36	0.15	49	0.45	0.22
Weight	54	6.24	3.70	54	7.52	5.42
Plat. Wid.	47	1.73	0.65	47	1.65	0.64
L/W (Perc.)	47	1.25	0.27	49	1.70	0.47
L/W (Flake)	54	1.32	0.28	54	1.84	0.43

Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake; Angle, in degrees, between percussion axis and flake axis, measured on interior (ventral) face with bulbar end toward observer (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Wid. (Maximum Width), measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thk. (Platform Thickness), measured on striking platform at point of impact from interior (ventral) to exterior (dorsal) face (perpendicular to interior); Weight, maximum weight of specimen; Plat. Wid. (Platform Width), measured at interior (ventral) face; L/W (Perc.) (Length/Width Ratio), using the percussion axis length; L/W (Flake) (Length/Width Ratio), using the maximum flake axis length.

TABLE 1.16. Metric Attributes of Kunji and Bisitun Scrapers.

	Single (Types 9-11)		Double (Types 12-17)		Convergent (Types 18-21)	
	Kunji	Bisitun	Kunji	Bisitun	Kunji	Bisitun
LENGTH (mm)						
Mean	44.8	52.7	46.4	55.6	43.9	48.9
(S.D.)	(8.6)	(12.9)	(8.5)	(12.1)	(9.2)	(12.9)
N	294	116	83	68	99	66
WIDTH (mm)						
Mean	26.2	24.4	26.4	24.8	25.5	22.7
(S.D.)	(6.1)	(6.5)	(5.1)	(6.8)	(5.8)	(5.8)
N	294	116	83	68	99	66
THICKNESS (mm)						
Mean	5.2	5.6	4.7	5.5	5.2	5.5
(S.D.)	(2.2)	(3.8)	(1.8)	(1.8)	(2.2)	(2.7)
N	224	116	67	68	69	66
WEIGHT (gm)						
Mean	10.4	n.a.	10.4	n.a.	9.7	n.a.
(S.D.)	(5.4)		(5.0)		(5.4)	
N	294		83		99	
PLATFORM AREA (cm^2)						
Mean	0.93	n.a.	0.78	n.a.	1.07	n.a.
(S.D.)	(0.66)		(0.46)		(0.69)	
N	200		61		59	
SURFACE AREA/PLATFORM AREA						
Mean	21.1	n.a.	23.2	n.a.	17.4	n.a.
(S.D.)	(24.5)		(17.9)		(18.2)	
N	200		61	59		

Bisitun data from Dibble (1984a); n.d. (data not available); transverse scrapers (Types 22-24) included with single scrapers at Bisitun

Length:	Kunji and Bisitun (measured from point of percussion to most distal edge)
Width:	Kunji (measured perpendicular to percussion axis length); Bisitun (measured perpendicular to length)
Thickness:	Kunji (measured at platform); Bisitun (measured at intersection of length and width)
Platform Area:	Platform width x Platform thickness
Surface Area:	Maximum length x Maximum width

TABLE 1.17. Scraper Retouch Intensity at Kunji and Bisitun.

	(1) Light		(2) Medium		(3) Heavy		(4) Stepped		Average Retouch Intensity
	N	(%)	N	(%)	N	(%)	N	(%)	
SINGLE SCRAPER									
Kunji (N=285)	125	(44)	129	(45)	28	(9)	5	(2)	1.69
Bisitun (N=295)	71	(24)	166	(56)	29	(10)	29	(10)	2.05
DOUBLE SCRAPER									
Kunji (N=78)	21	(27)	42	(54)	13	(17)	2	(2)	1.95
Bisitun (N=242)	24	(10)	114	(47)	44	(18)	60	(25)	2.58
CONVERGENT SCRAPER									
Kunji (N=88)	12	(14)	46	(52)	23	(26)	7	(8)	2.28
Bisitun (N=173)	8	(5)	65	(38)	48	(22)	62	(36)	3.06
MOUSTERIAN POINT									
Kunji (N=60)	19	(32)	36	(60)	5	(8)	0	(0)	1.77

Retouch intensity after Dibble (1984b:433, 1987a:110).
Bisitun data from Dibble (1984b); data on Bisitun Mousterian points not available.

TABLE 1.18. Retouch Intensity of Single Side-Scrapers at Kunji Cave.

	(1) Light		(2) Medium		(3) Heavy		(4) Stepped		Average Retouch Intensity
	N	(%)	N	(%)	N	(%)	N	(%)	
Edge Opposite									
Backed (N=173)	64	(37)	80	(46)	24	(14)	5	(3)	1.83
Normal (N=114)	61	(53)	49	(43)	4	(4)	0	(0)	1.50
Naturally Backed Only (N=48)	15	(31)	18	(38)	12	(25)	3	(6)	2.06

Retouch Intensity after Dibble (1984b:433, 1987a:110)

Edge Opposite: Backed = Naturally Backed, Cortical, and Non-Cortical Steep (≥45 degrees)
Normal = Non-Cortical Acute (<45 degrees)

TABLE 1.19. Metric Attributes of Kunji Cave Mousterian Points and Convergent Scrapers.

	Moust. Pts. and Elongated Mousterian Points (Types 6-7)			Convergent Scrapers (Types 18-20)			Moust. Pts. and Convergent Scrapers Combined		
Attribute	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Perc. Len.	51	3.34	0.90	57	3.82	0.81	108	3.59	0.88
Flake Len.	61	4.15	0.83	85	4.47	0.86	146	4.34	0.86
Angle	51	-3.53	14.43	57	0.37	11.68	108	-1.47	13.14
Max. Wid.	61	2.49	0.53	85	2.48	0.56	146	2.48	0.55
Dist. Wid.	51	1.27	0.58	57	1.47	0.58	108	1.38	0.59
Plat. Thk.	53	0.52	0.17	56	0.50	0.22	109	0.51	0.19
Weight	61	6.98	3.34	85	9.65	5.28	146	8.54	4.74
Plat. Wid.	50	1.71	0.55	50	1.84	0.71	100	1.77	0.64
Tip Thk.	58	0.45	0.11	55	0.55	0.18	113	0.50	0.16
Tip Angle	58	57.07	11.77	55	55.82	10.53	113	56.46	11.15

Linear measurements in centimeters; weight in grams; Perc. Len. (Percussion Axis Length), maximum length of percussion axis measured perpendicular to striking platform at point of impact; Flake Len. (Maximum Flake Axis Length), maximum length of flake axis measured from striking platform at point of impact to most distant distal point of flake; Angle, in degrees, between percussion axis and flake axis, measured on interior (ventral) face with bulbar end toward observer (minus, flake axis to left of percussion axis; positive, flake axis to right of percussion axis); Max. Wid. (Maximum Width), measured perpendicular to percussion axis; Dist. Wid. (Distance from Butt to Maximum Width), measured along percussion axis from striking platform at point of impact; Plat. Thk. (Platform Thickness), measured on striking platform at point of impact from interior (ventral) to exterior (dorsal) face (perpendicular to interior); Weight, maximum weight of specimen; Plat. Wid. (Platform Width), measured at interior (ventral) face; Tip Thk. (Tip Thickness), measured at arbitrary point located one-third of distance along line (maximum flake axis) from tip of tool where lateral edges converge to point of impact on striking platform; Tip Angle, "sharpness" of tool tip, measured by angle, in degrees, formed by two lines from tip that are tangent to lateral edges of specimen at point on each side where line, drawn perpendicular to flake axis through locus where tip-thickness measurement was made, intersects lateral edges.

Figure 1.1. Map of Iran showing the approximate location of Kunji Cave.

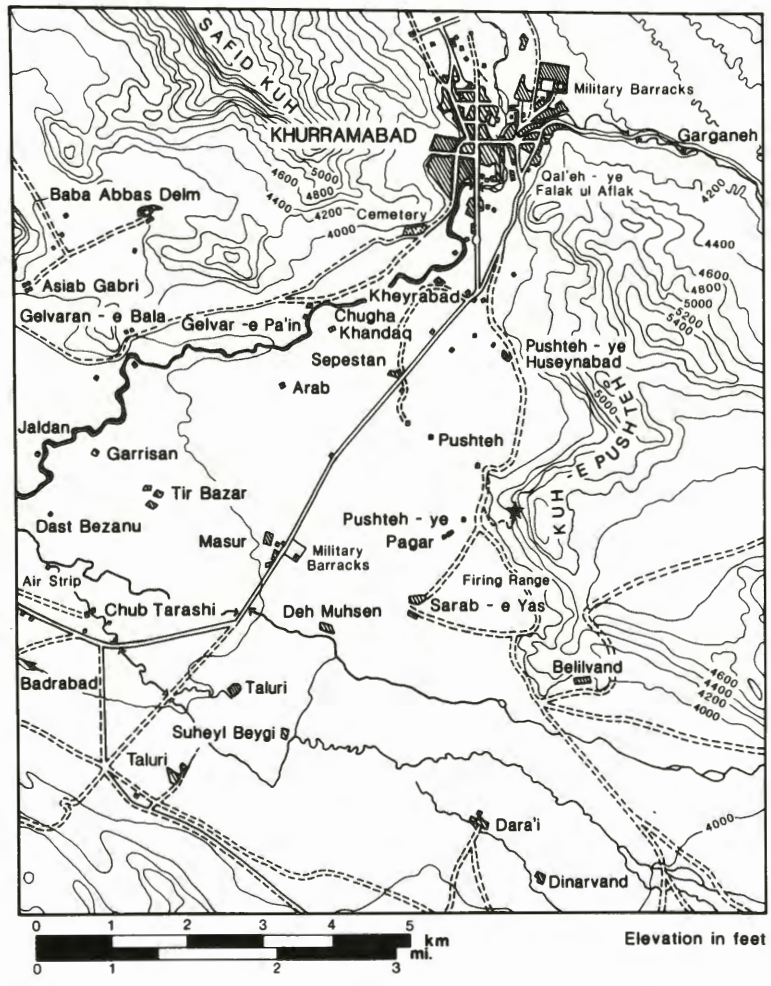

Figure 1.2. Topographic map of a portion of the Khorramabad Valley showing the location of Kunji Cave (star in the right center of the figure directly west of word "Kuh" in Kuh-e Pushteh). North is to the top of the figure.

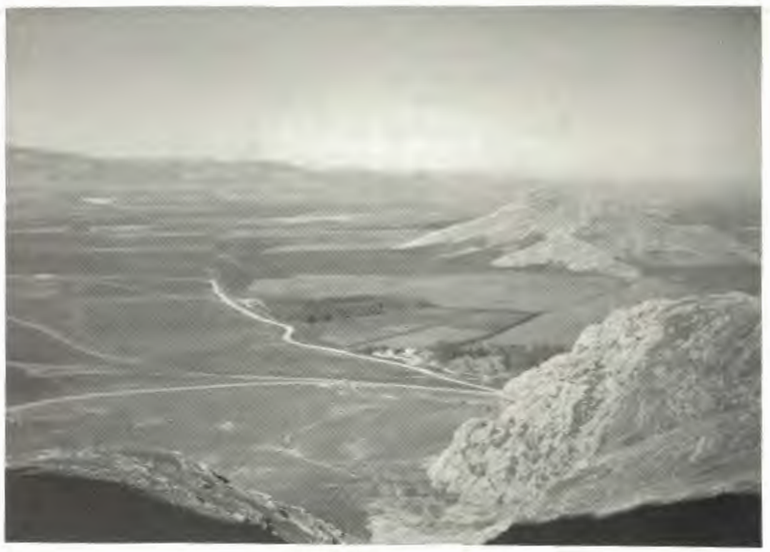

Figure 1.3. *View of a portion of Khorramabad Valley from the mouth of Kunji Cave, looking approximately west. Note the small hill, Gar Arjeneh, to the right of center.*

Figure 1.4. *View of the mouth of Kunji Cave from an adjacent hill slope. Note the prominent cone of sediment in the mouth of the cave ("mouth cone") and retaining wall to left of cave constructed in 1969 to hold backdirt from the excavation.*

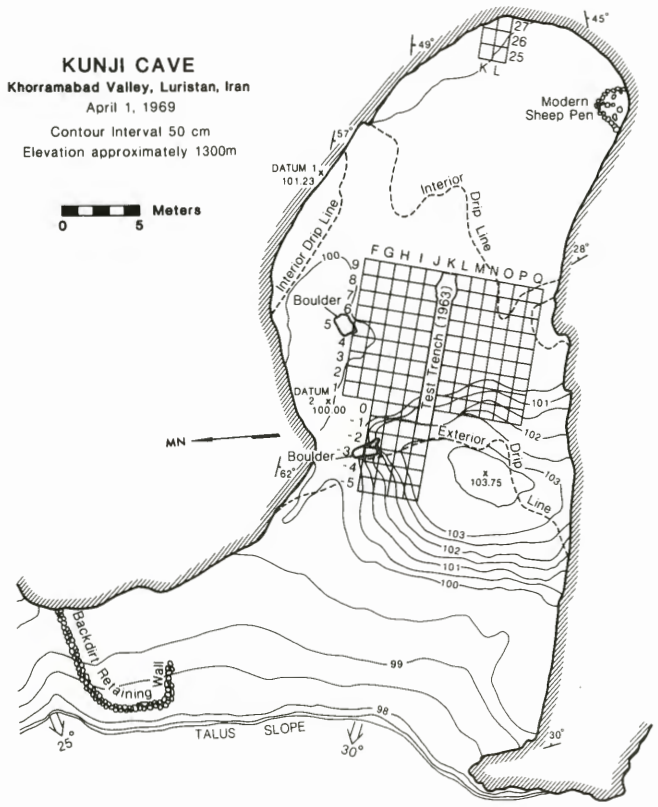

Figure 1.5. *Plan of Kunji Cave showing the location of Hole and Flannery's 1963 test trench and the 1969 grid system. Symbols along the cave margins denote the dip-strike orientation of the limestone bedrock of the cave walls. Datum 1 was the elevation reference marker attached to the cave wall (arbitrary elevation +101.23 m); datum 2 was the location of mapping transit during the excavation (set at an arbitrary elevation of +100.00 m. Note the position of modern drip line).*

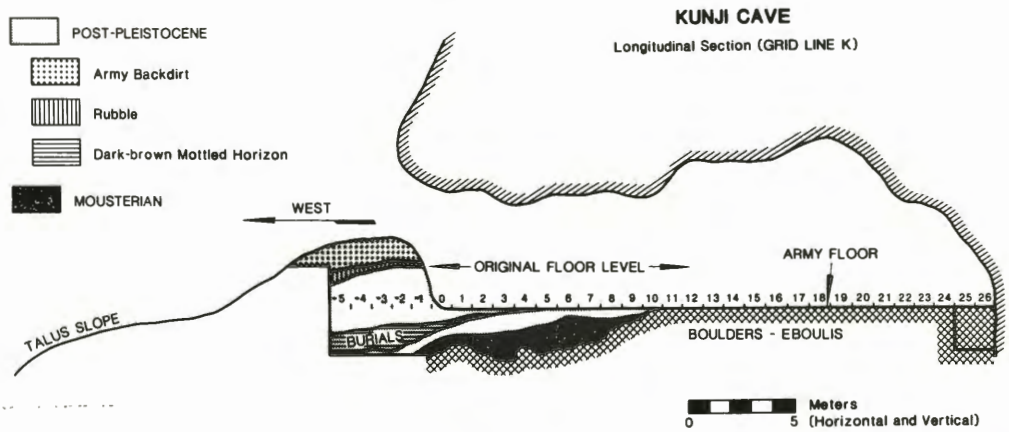

Figure 1.6. *Simplified longitudinal stratigraphic section of Kunji Cave (drawn along grid line K). "Level with 'burials'" refers to Jemdet Nasr age tombs. The "Main Component of the Mousterian" is shown in dark black. Note artificially flattened floor created by the Iranian army to house munitions in the cave.*

Figure 1.7. *Porcupine and rodent disturbance in ceramic-period deposits (shown after the removal of den and tunnel fill). Hole and Flannery's 1963 test trench is partly visible at the left of the photo.*

Figure 1.8. *Porcupine and rodent disturbance in deposits of "Main Component of Mousterian" (shown after the removal of den and tunnel fill). Hole and Flannery's 1963 test trench is partly visible at the right of the photo.*

Figure 1.9. *"Boulder horizon" (collapsed retaining wall and/or sheep-goat pens) at the base of the ceramic-period deposits. Hole and Flannery's 1963 test trench is visible to the left of the center in the photograph.*

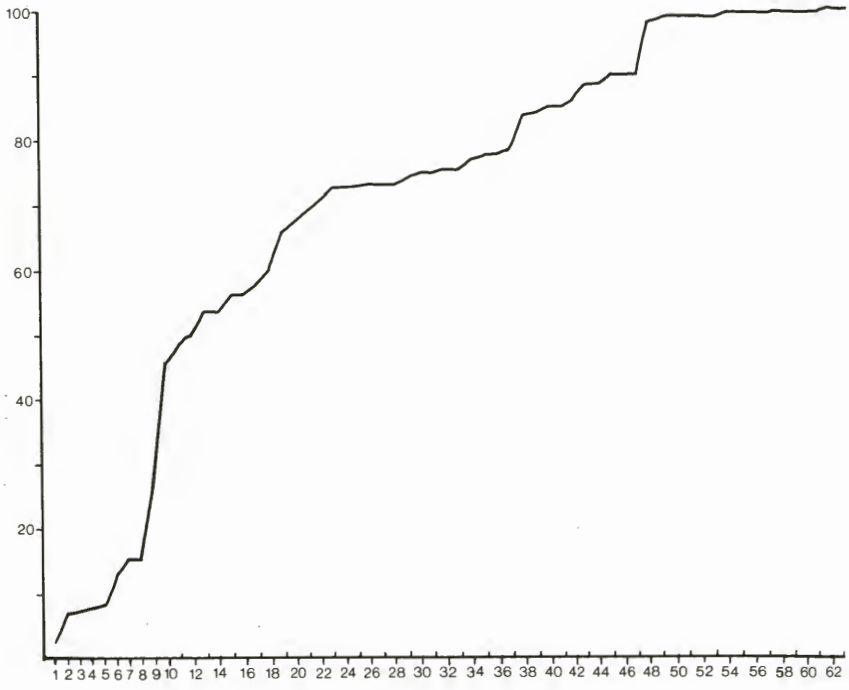

Figure 1.10. *Kunji Cave cumulative graph (real count).*

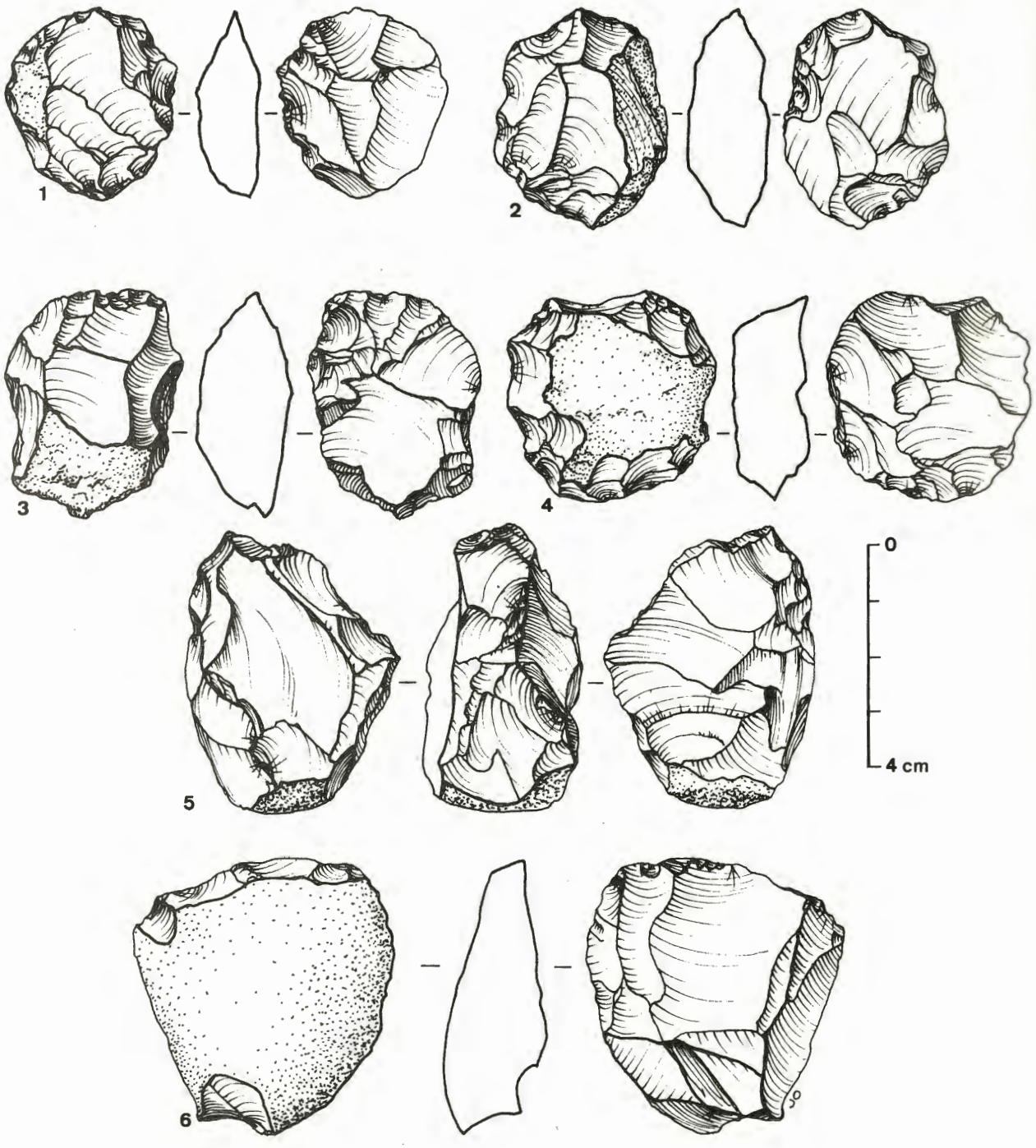

Figure 1.11. *Kunji Cave. Cores (number in figure followed by original sequential item number): 1-2503; 2-2491; 3-2531; 4-2596; 5-2533; 6-2626 (drawn by Judith J. Ogden).*

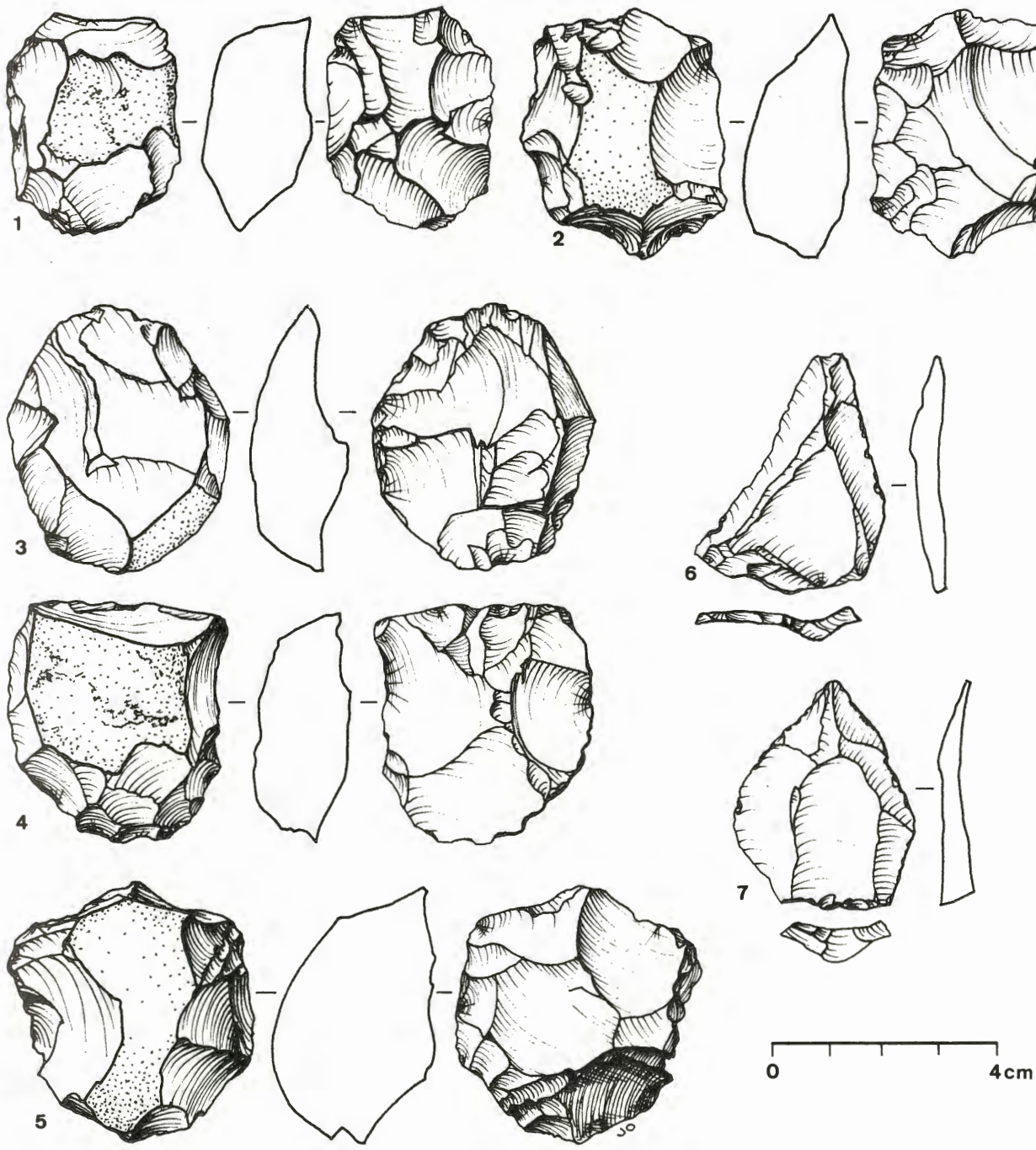

Figure 1.12. *Kunji Cave. Cores (1-5) and Levallois points (6-7) (number in figure followed by original sequential item number): 1-2587; 2-2631; 3-2591; 4-2586; 5-2539; 6-1663; 7-1513 (drawn by Judith J. Ogden).*

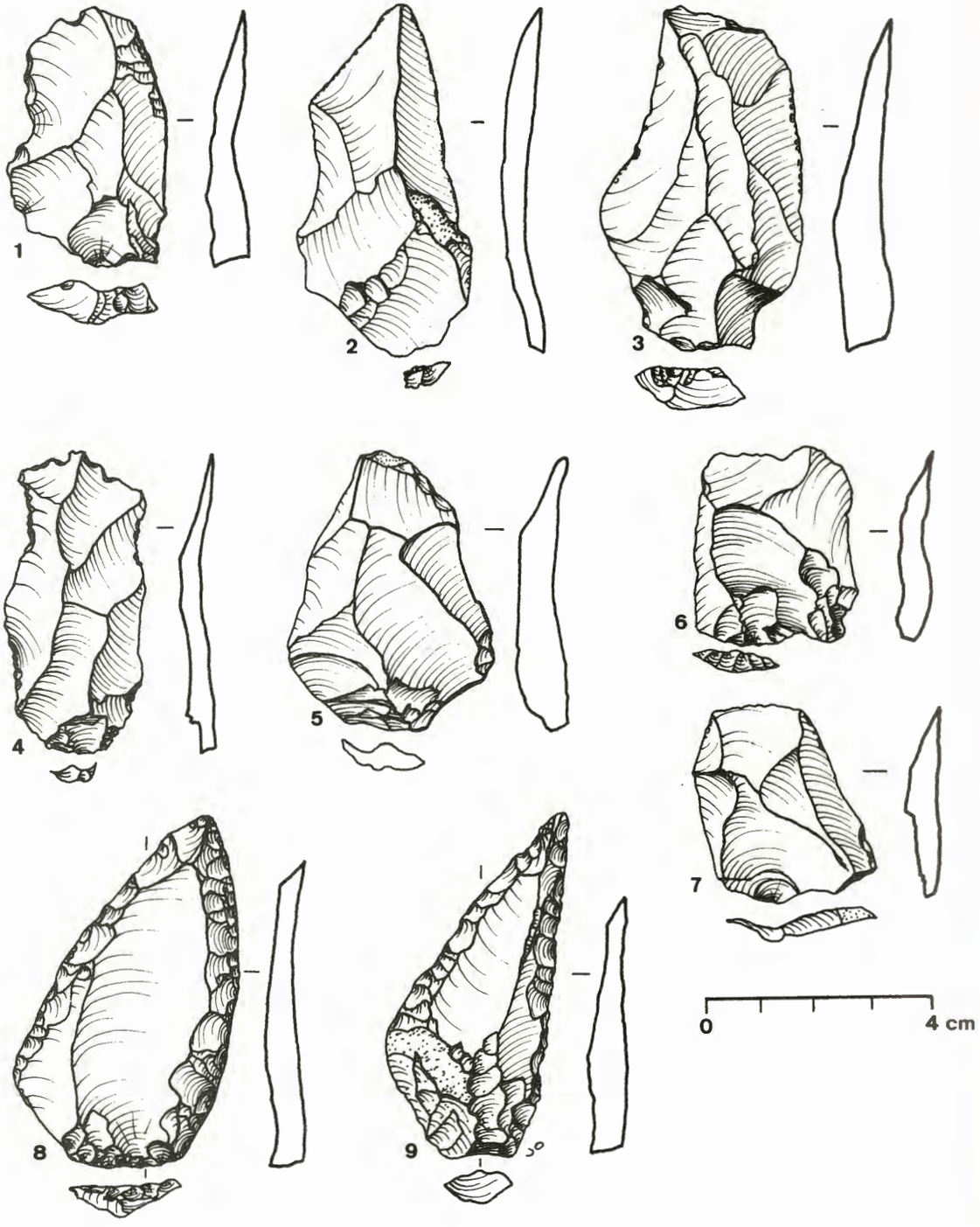

Figure 1.13. Kunji Cave. Levallois flakes (1-7) and elongated Mousterian points (8-9) (number in figure followed by original sequential item number): 1-919; 2-1024; 3-1080; 4-1151; 5-1212; 6-1239; 7-1523; 8-25; 9-14 (drawn by Judith J. Ogden).

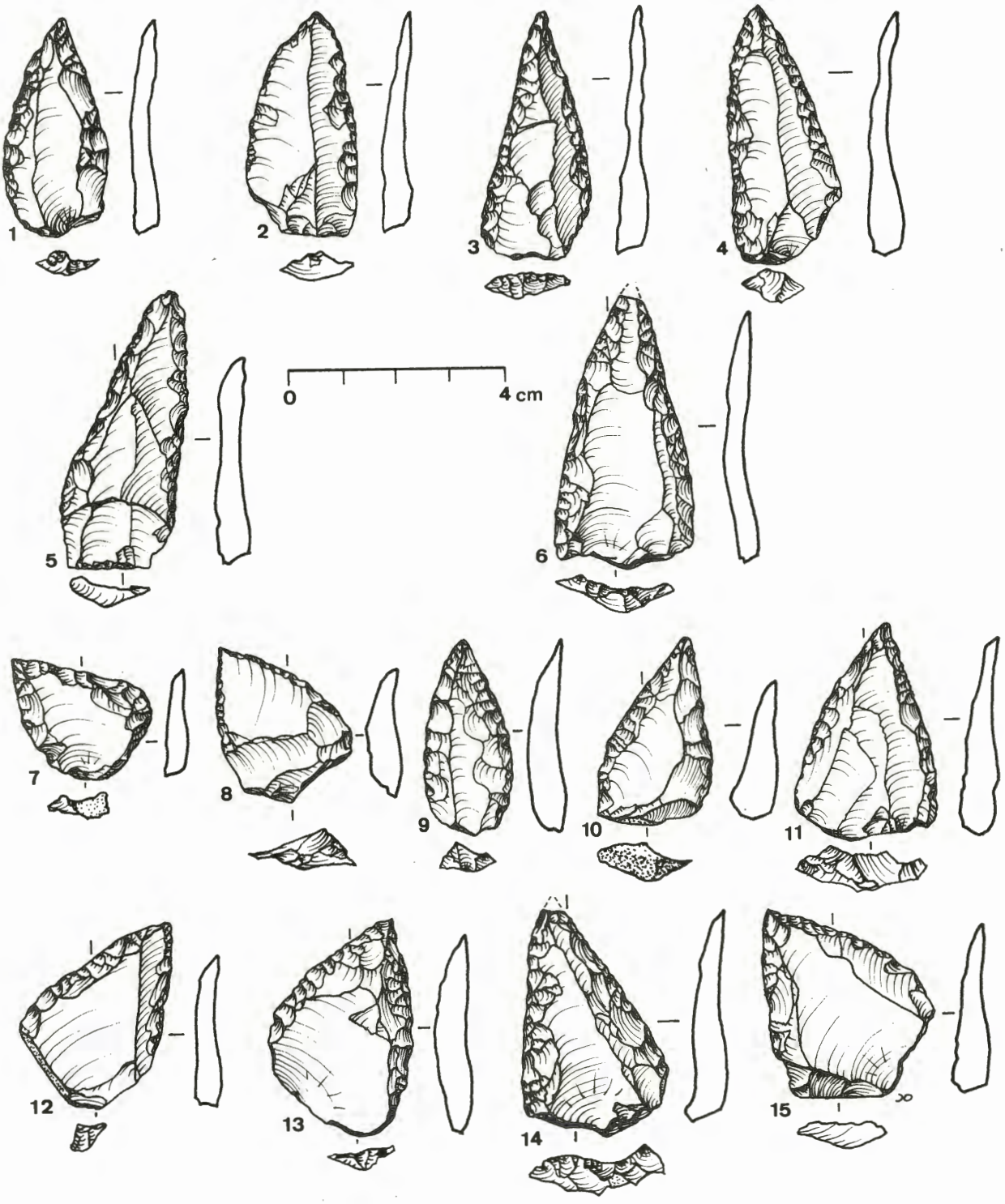

Figure 1.14. *Kunji Cave. Elongated Mousterian points (1-6) and Mousterian points (7-15) (number in figure followed by original sequential item number): 1-15; 2-133; 3-85; 4-40; 5-32; 6-30; 7-150; 8-135; 9-56; 10-58; 11-31; 12-64; 13-47; 14-52; 15-45 (drawn by Judith J. Ogden).*

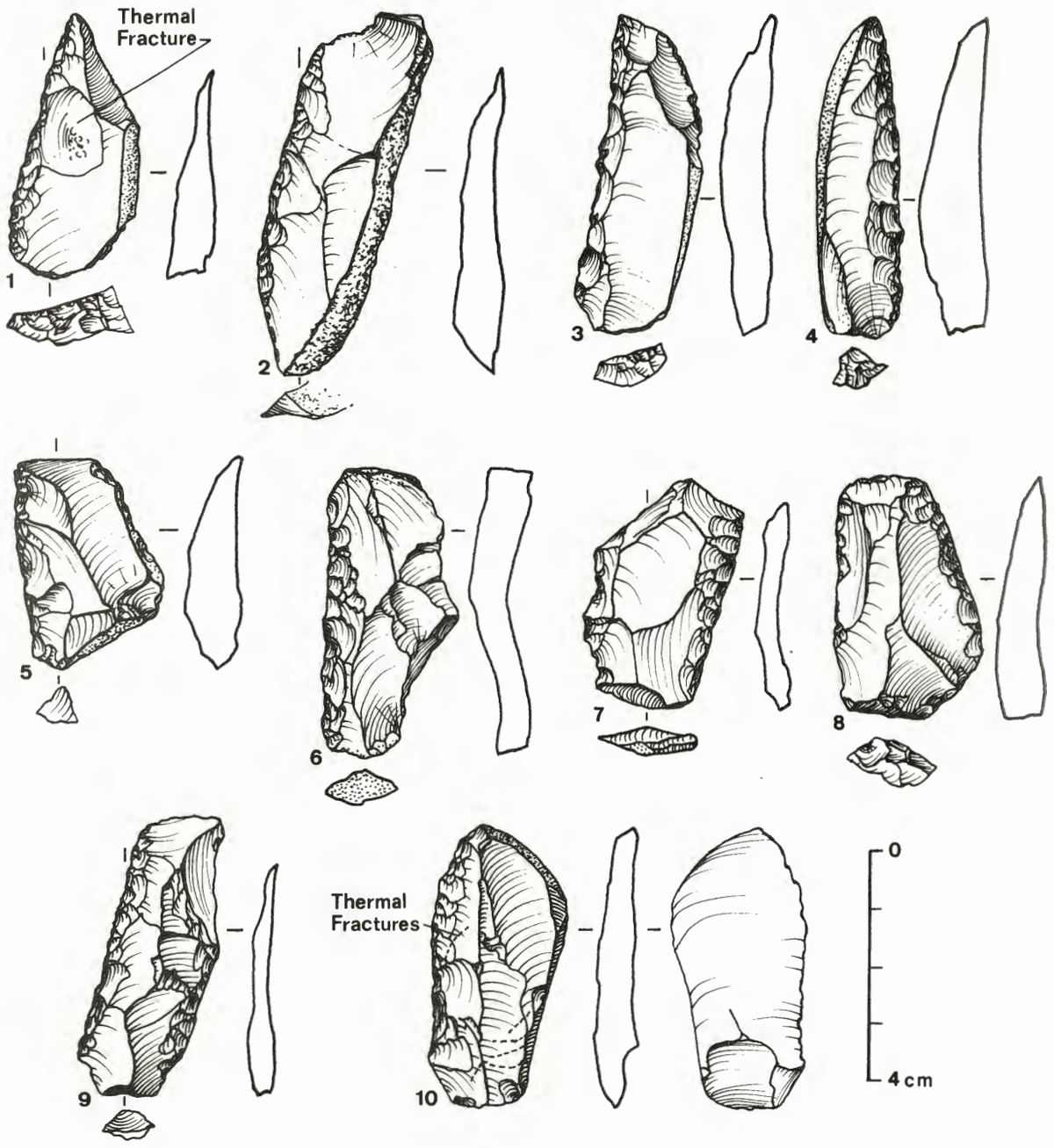

Figure 1.15. *Kunji Cave. Single straight side-scrapers (number in figure followed by original sequential item number): 1-405; 2-422; 3-436; 4-449; 5-502; 6-466; 7-474; 8-517; 9-618; 10-620 (drawn by Judith J. Ogden).*

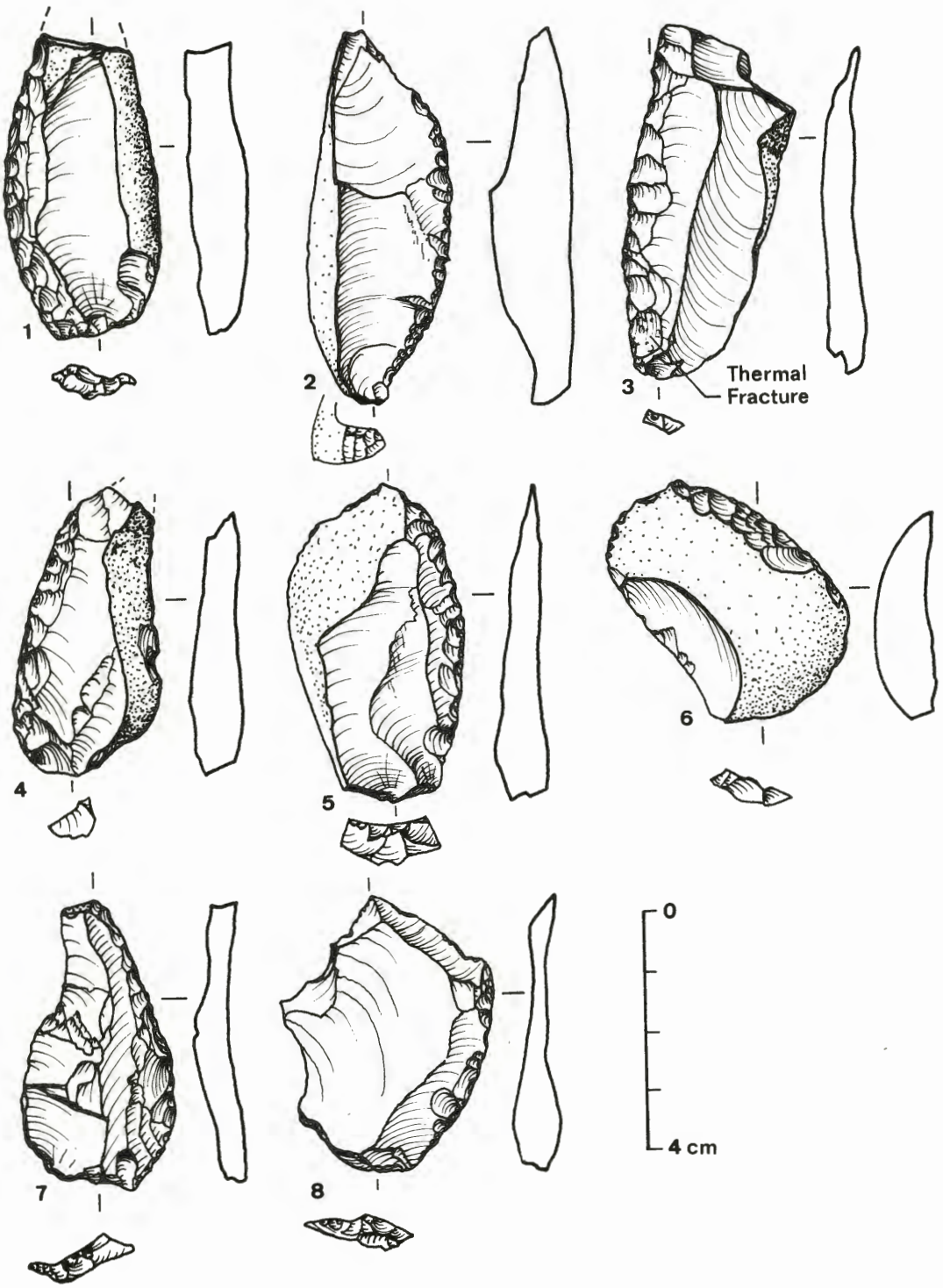

Figure 1.16. *Kunji Cave. Single convex side-scrapers (number in figure followed by original sequential item number): 1-441; 2-444; 3-450; 4-497; 5-545; 6-511; 7-522; 8-601 (drawn by Judith J. Ogden).*

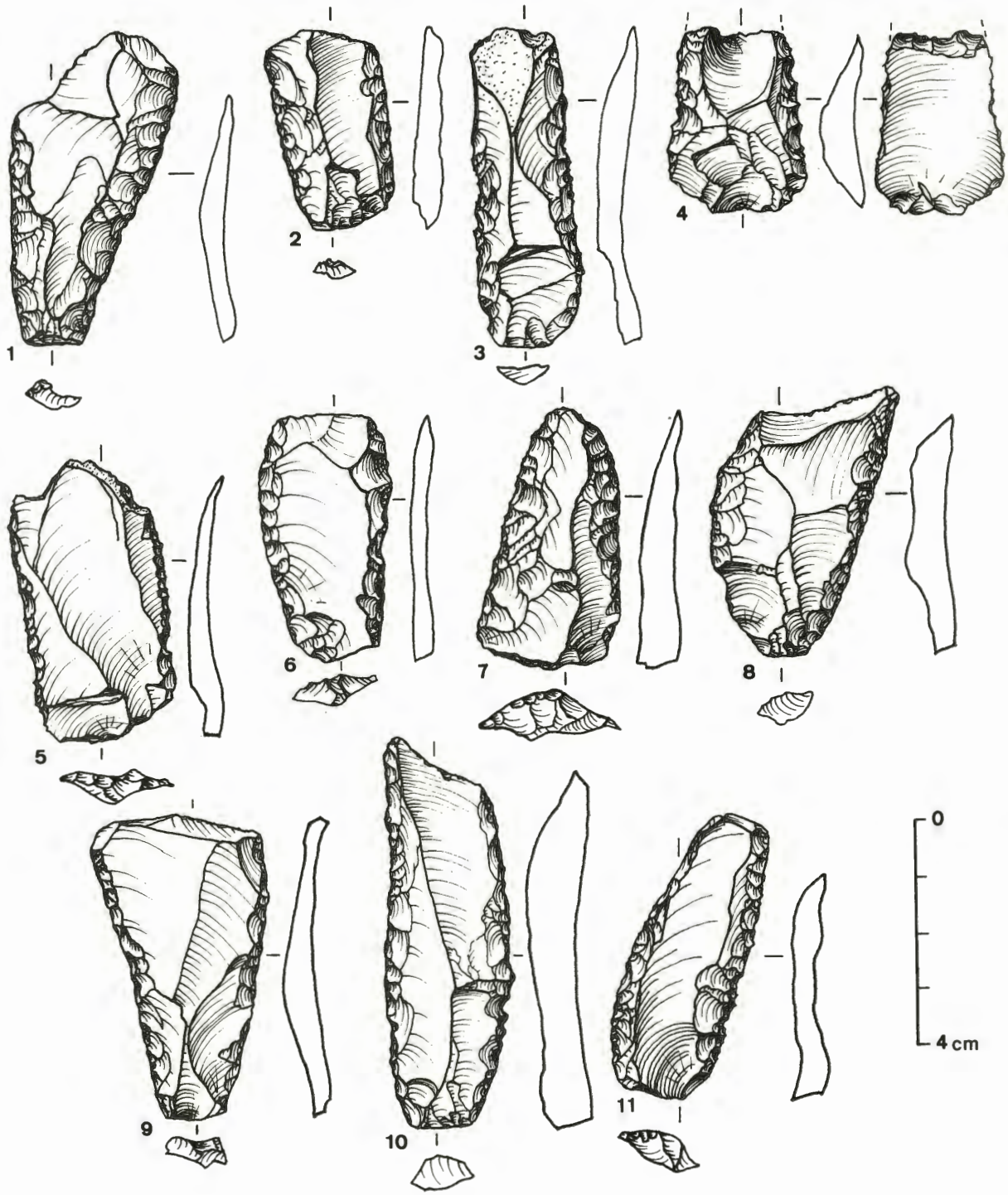

Figure 1.17. *Kunji Cave. Double straight (1-5) and double straight-convex (6-11) side-scrapers (number in figure followed by original sequential item number): 1-185; 2-189; 3-255; 4-249 (truncated-faceted); 5-305; 6-170; 7-177; 8-181; 9-176; 10-183; 11-201 (drawn by Judith J. Ogden).*

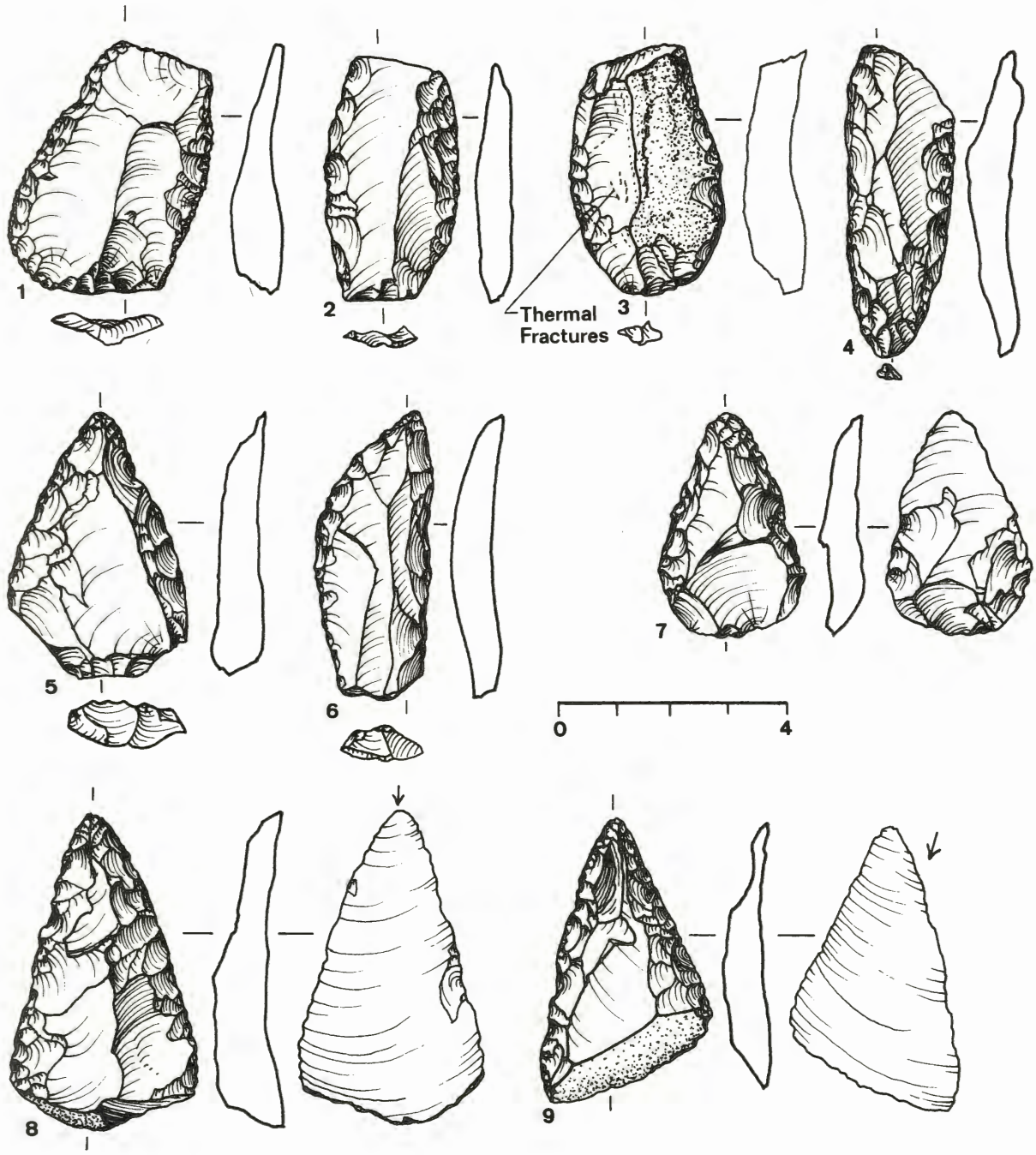

Figure 1.18. *Kunji Cave. Double biconvex side-scrapers (1-4) and Convergent straight side-scrapers (5-9) (number in figure followed by original sequential item number): 1-180; 2-198; 3-273; 4-193; 5-90; 6-167; 7-65 (bulb removed); 8-7; 9-86 (drawn by Judith J. Ogden).*

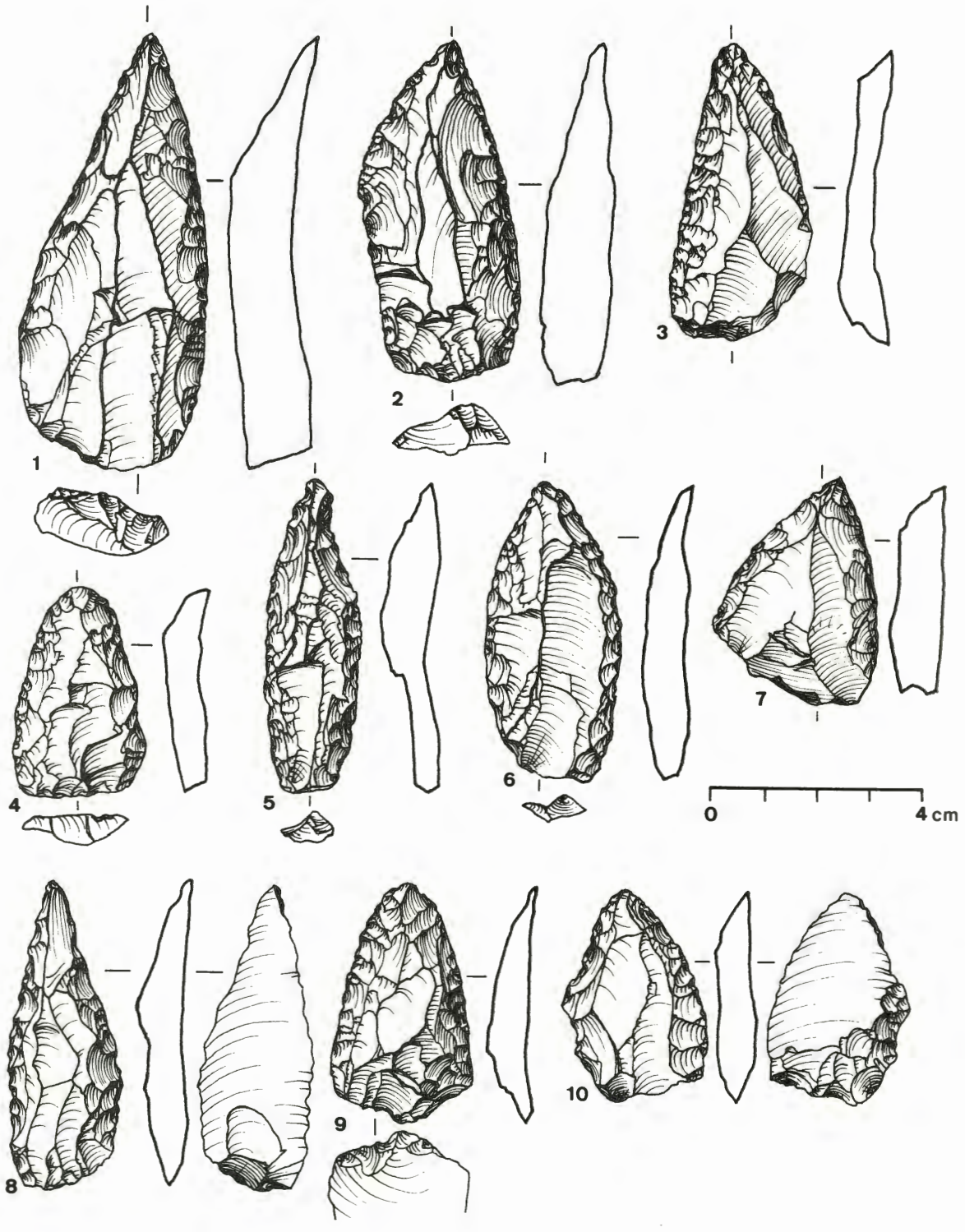

Figure 1.19. *Kunji Cave. Convergent convex side-scrapers (number in figure followed by original sequential item number): 1-1; 2-2; 3-4; 4-21; 5-28; 6-36; 7-54; 8-33; 9-50 (truncated- faceted); 10-72 (bulb-removed) (drawn by Judith J. Ogden).*

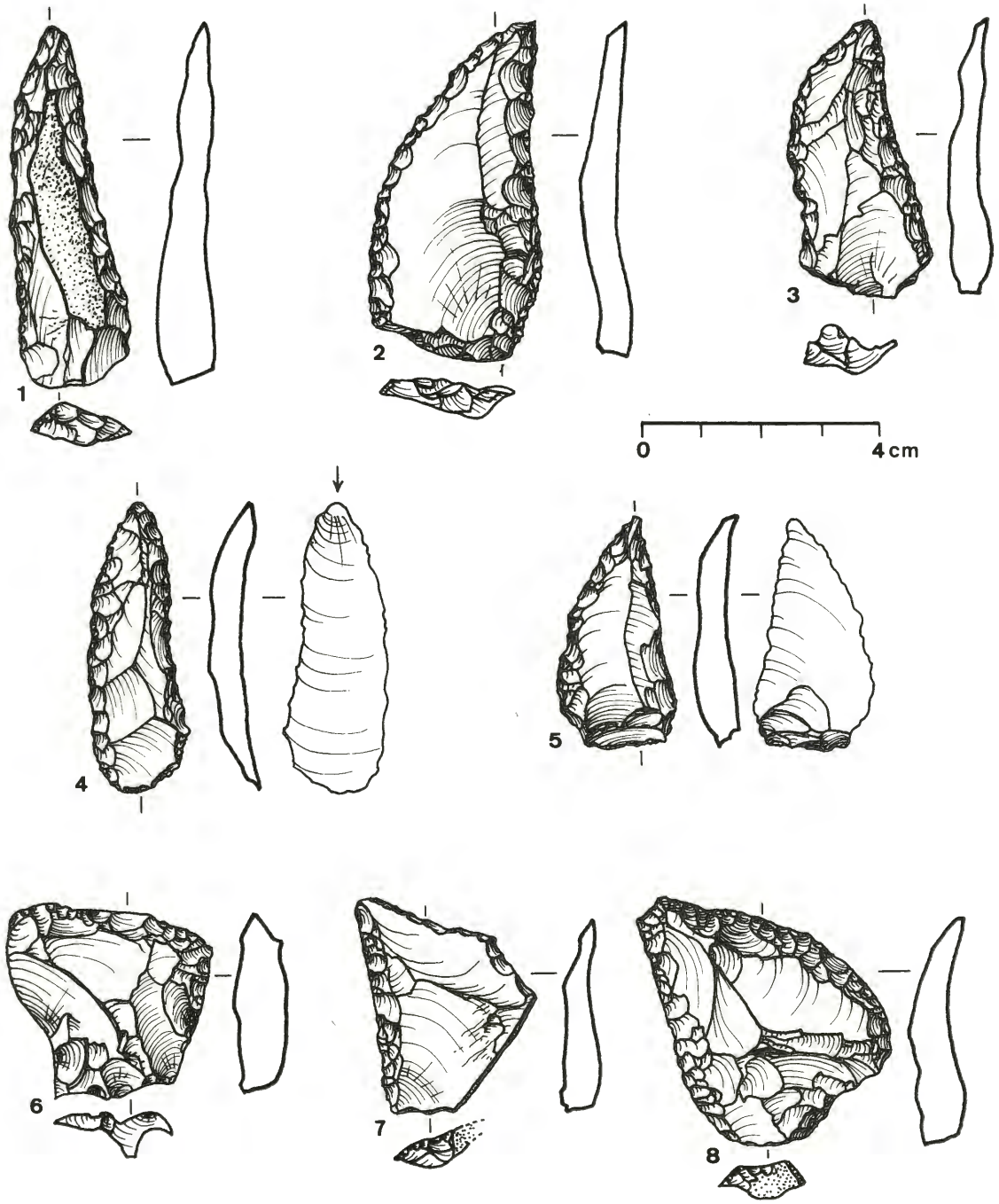

Figure 1.20. *Kunji Cave. Convergent concave side-scrapers (1-5) and déjeté scrapers (6-8) (number in figure followed by original sequential item number): 1-17; 2-24; 3-126; 4-13; 5-129 (truncated-faceted); 6-236; 7-104; 8-148 (drawn by Judith J. Ogden).*

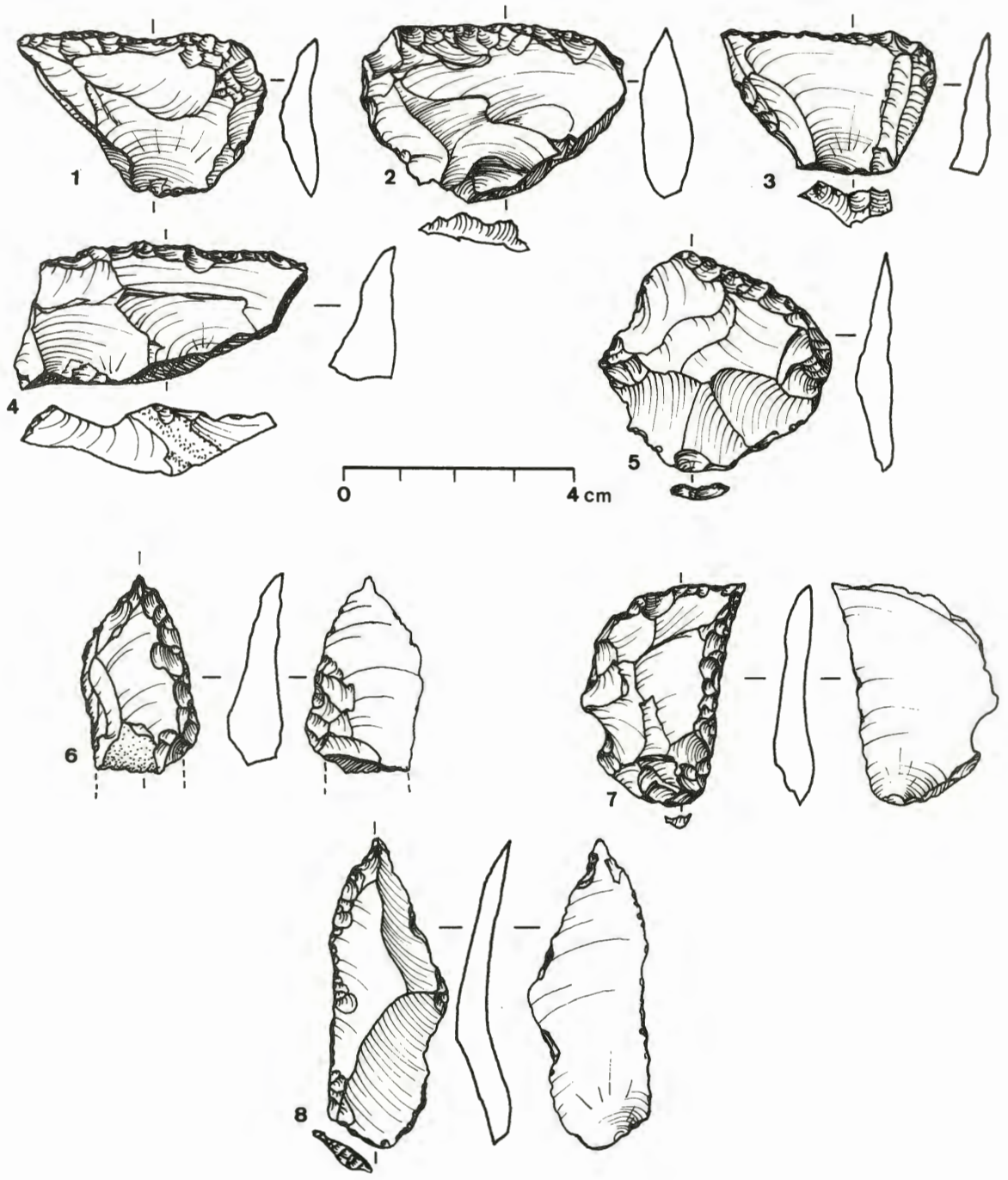

Figure 1.21. *Kunji Cave. Transverse side-scrapers (1-5) and percoirs ("piercers") (6-8) (number in figure followed by original sequential item number): 1-434; 2-531; 3-841; 4-438; 5-725; 6-258; 7-152; 8-746 (drawn by Judith J. Ogden).*

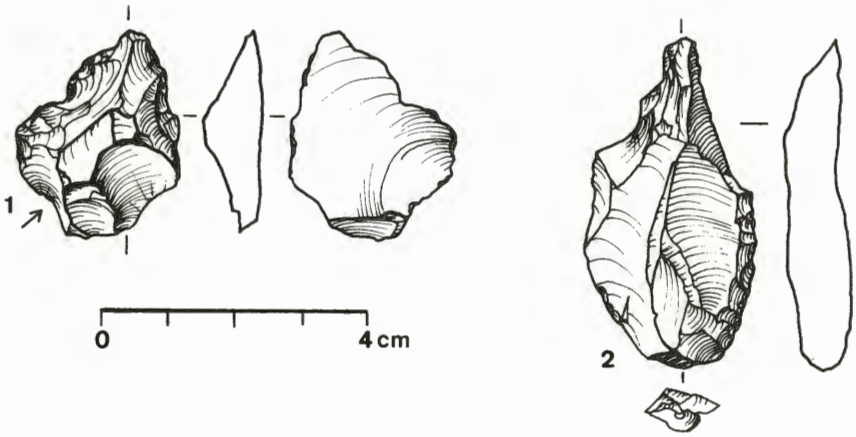

Figure 1.22. *Kunji Cave. Denticulates (number in figure followed by original sequential item number): 1-359; 2-627 (drawn by Judith J. Ogden).*

2

The Middle Paleolithic Industries of Warwasi

Harold L. Dibble and Simon J. Holdaway

Warwasi is a rockshelter located about 11 km from Bakhtaran (Kermanshah, Iran) in the Tang-i-Knesht Valley (see Fig. 2.1). It was excavated by Bruce Howe as part of the Iraqi-Jarmo project, under the general direction of Robert Braidwood (Braidwood 1960; Braidwood et al. 1960, 1961; Braidwood and Howe 1960). The material from Warwasi was originally housed in the Oriental Institute, University of Chicago, but is now on permanent loan to The University Museum, University of Pennsylvania.

At Warwasi, a trench of approximately 8 m by 2 m was excavated along the northern edge of the rockshelter to a depth of 5.6 m. All sediment was screened, and all the lithic fragments were recovered. No natural layers could be defined, so excavation proceeded in 10 cm arbitrary levels. A total of fifty-five such levels were defined (except levels B and R, which were approximately 20 cm and 15 cm thick, respectively), labeled from A at the top to CCC at the bottom. Mousterian levels were encountered after approximately 3 m of material containing Zarzian and Baradostian assemblages had been removed (see Olszewski, this volume, for descriptions of these overlying industries), and no clear stratigraphic break existed between the Middle and Upper Paleolithic levels. The present analysis deals with Levels JJ through CCC. Because any single level contains too few artifacts for analysis, we have arbitrarily grouped these levels into four major units, A-D, composed of adjacent levels.

Table 2.1 and Figure 2.2 present the typological counts (following the Bordes 1961 typology) of the Mousterian assemblages from these four units, and Table 2.2 presents the corresponding typological indices. Representative pieces are illustrated in Figures 2.3-2.7. Overall there are relatively high frequencies of scrapers and points, and relatively fewer denticulates/notches. The two lowermost units (Units A and B) appear quite similar, but the uppermost, Unit D, is characterized by having the fewest single scrapers, and relatively more convergent scrapers, notches/denticulates, and Upper Paleolithic types. In fact, studies still in progress suggest that this uppermost Unit may not represent true Middle Paleolithic materials. Although for the moment we will consider it as such in this paper, it should be emphasized that our interpretations of the assemblages in this Unit are still preliminary. Unit C seems to be intermediate between these two extremes, though more similar to the underlying levels. The higher frequency of Upper Paleolithic elements may be due to the use of arbitrary levels, and it is also possible that a certain degree of mixture occurred because of rodent disturbance. Such bioturbation has been observed at Kunji (Speth 1971; Baumler and Speth, this volume). On the other hand, some continuity may be apparent between the underlying Mousterian and the early Baradostian material.

An earlier study based on the Bisitun material (Dibble 1984a) suggested that the major scraper categories of single, double, and convergent forms reflected a continuum of reduction of the tools through repeated resharpening. In this view, the single scrapers represent the least reduced pieces, while double and convergent forms reflect the most reduction of blanks through resharpening. At Warwasi, most of the important morphological aspects of the scrapers are consistent with this model (see Table 2.3), especially the reduction in the ratio of flake area/platform area (F=3.956, df=2 and

128, P=.021) and the increased retouch intensity (Kruskal-Wallis H=50.331, df=2, P<.0001) from single, double, to convergent forms. Other aspects are not so consistent, however, as the convergent scrapers from Warwasi are not significantly shorter than the single and double scrapers (F=.344, df=2 and 148, P=.709) and the single scrapers have a much greater maximum width (F=10.324, df=2 and 147, P<.001). Nonetheless, and consistent with the model, the double and convergent forms were both reduced to what is statistically the same maximum width (t=.903, df=79, p=.369). Thus, it appears that similar models of tool resharpening can be used to interpret the scrapers from Warwasi and Bisitun, though differences between the two sites suggest that variations in the pattern of resharpening can be detected. Such an interpretation of scraper morphology tied to repeated resharpening has been extended to other Middle Paleolithic assemblages in the Near East and Europe (Barton 1990; Tzonev 1991; Roebroeks et al. 1988; Dibble 1987, 1989).

Recent studies of the Middle Paleolithic material from Kunji (Baumler and Speth, this volume) are largely consistent with these interpretations, though some differences are apparent and are emphasized by those authors. The most significant of these differences is that the Kunji single scrapers appear to have been more extensively reduced, and thus do not seem representative of initial stages of reduction. However, it should be noted that many of these scrapers at Kunji were made on blanks with abrupt cortical backs along one edge, which effectively precluded the retouching of that edge. Therefore, any resharpening and rejuvenation of these pieces could not easily have extended to those edges, and thus reduction continued in from the single edge. Hence, such a pattern does not argue against reduction but rather underscores the effects and constraints imposed on retouch by various aspects of blank morphology (see Dibble 1991a).

In fact, the reduction sequence seen at Warwasi seems to be the best explanation for the presence of the heavily retouched, parallel-sided double scrapers (see Figure 2.5:2-4), termed "rods" by Hole and Flannery (1967). Originally thought to be diagnostic of the later Baradostian, they definitely occur in Middle Paleolithic contexts at Warwasi, Bisitun, and Shanidar (Akazawa 1975).

If the model for continued resharpening is correct, then a major temporal change can be seen at Warwasi that could be interpreted as increasing reduction of the scrapers through time. This can be most clearly shown by computing an index of the more reduced scraper types (doubles, convergent, and transverse forms, including limaces and the so-called points) relative to the total number of types 6-24.[1] This index, computed for each of the four units, is presented in Table 2.2. According to these values, a major typological pattern through time seems to be one of increasing reduction of the scrapers. Perhaps this reflects diminishing raw material resources in the area around the rockshelter through time. Similar and/or analogous patterns have been noted at a number of Lower and Middle Paleolithic sites in the Near East and Europe (Dibble 1991b), which suggests that raw material availability should not always be considered constant during the occupation of a single site.

An important typological component of Warwasi that was also noted for Bisitun (Dibble 1984b) are the so-called truncated-faceted pieces (see Fig. 2.6). These are characterized by an inverse truncation that serves as a striking platform for the removal of one or more small flakes from the (usually) exterior surface of the blank. It usually results in a kind of denticulation along the exterior portion of the truncated edge. This kind of retouch has been noted in Levantine Mousterian assemblages (Schroeder 1969; Solecki and Solecki 1970; Crew 1975; Nishiaki 1985) and seems to occur in other parts of the Old World in the Lower and Middle Paleolithic (Debénath 1988; Turq and Marcillaud 1976; Callow 1986:311-314), Upper Paleolithic (Otte 1980), and ethnographic contexts (Leakey 1931:99-100).

Whether these pieces represent formal tools or whether they are simply a technological attribute (see Debénath 1988; Geneste 1985:238-239) has not yet been determined. At Warwasi, the retouch is located on the proximal (58.9%), distal (24.6%), both proximal and distal (10.9%), or lateral (5.4%) portions of the blank. Retouched tools from both Warwasi and Bisitun that exhibit truncated-faceting retouch are usually made on thicker blanks (see Table 2.4), probably because a certain minimum thickness is required for removal of the exterior flake. This would account for the higher frequency of this kind of retouch on the proximal end where, owing to the bulb of percussion, the blank is usually thickest. This kind of retouch occurs on otherwise unretouched pieces (N=23) and on blanks exhibiting other kinds of retouch. When other retouch is present, it seems that no special typological class is

heavily favored (see Table 2.5), although the notches/denticulates from Warwasi do have a slightly (and statistically significant) higher frequency of this feature. However, the lack of strong association suggests that the statistical significance is largly a result of the high sample size. At Bisitun, even this slight bias was not apparent (Dibble 1984b: Table 6), thus no significant associations between tool type and presence/absence of truncating-faceting were noted. In any event, this retouch is clearly not linked to the points alone and thus cannot be interpreted as a hafting modification for points (Coon 1951). Altogether, it appears as if this retouch produces a certain kind of desired edge that was functionally and technologically independent of other edges on the piece, retouched or not. If so, then the occurrence of this kind of edge preparation with other retouched edges on the same blank also reflects a reuse of already retouched blanks as sources of raw material. It may also be the case that the extremely small radial "cores" (see Fig. 2.7) are in fact radial "truncated-faceted" pieces.

Another interesting feature in the Warwasi material is the presence of "burin spalls" that exhibit a portion of previous scraper edge (see Fig. 2.6:5, 6). These may reflect a method of edge resharpening, as has been suggested for the Lower Paleolithic at La Cotte de St. Brelade in Jersey (see Cornford 1986). Certainly it results in typological burins (Fig. 2.6:2, 4)). It is interesting to note, however, that the technique of edge resharpening is technologically similar to the truncated-faceting technique described above, and that the latter technique also occurs in significant proportions at La Cotte. Furthermore, the relative proportions of truncated-faceted pieces at that site vary directly with proportions of these resharpening spalls (Callow 1986: Table 26.27), and both truncated-faceting and such edge resharpening occur on the same pieces. Whatever the ultimate interpretation of these pieces, they do suggest an interesting technological parallel between Zagros and western Europe.

The major consideration for selection of a blank for retouch seems to be size. Table 2.6 presents summary statistics of various metric observations of both retouched and unretouched pieces for all the combined units. On each dimension, retouched pieces are significantly larger than unretouched flakes. This is in agreement with data from Tabun (Dibble 1989: Table 1) and Houmian (Bewley 1984: Table III), and with Middle Paleolithic assemblages from Europe (Geneste 1985; Meignen 1988; Dibble 1991a; Rolland and Dibble 1990).[2] This conclusion suggests that size was an important criterian for choosing blanks to be retouched, especially for scrapers. It also implies that the unretouched flake component represents a sort of "negative" impression of what the inhabitants selected for retouching, in that they are what is left over. The important caveat for those who study only the debitage from lithic assemblages is that the unretouched flake populations are biased by the degree to which they have been "culled" for suitable blanks.

The Quina index is low throughout the sequence, perhaps surprisingly so considering the elevated scraper indices. This probably reflects the overall thinness of the blanks, however. That blank thickness seems to have an effect on retouch intensity is suggested by the fact that scrapers with normal or light retouch are thinner than those coded as having heavy or stepped (Quina or Demi-Quina) retouch (see Table 2.7). However, this also reflects the fact that thicker pieces are usually larger in area as well, and thus subject to more intensive reduction, which in turn leads to more intense retouch.

The principal technology for blank production at Warwasi involves the use of uni- and bidirectional flaking, though subradial and radial preparation occurs and, in fact, increases through time (see Table 2.8). The Levallois index is not high for any of the units, though the Levallois technique is definitely present in significant amounts (see Fig. 2.3).[3] The use of actual blade technique, with deliberate preparation showing longitudinal, parallel exterior flake scars, is low (represented in Table 2.8 by the percentage of true blades). However, if blades are defined as any flake whose length is more than twice its width (reflected by the Ilam, or Blade, index), then all the major units are highly laminar. The faceting indices also seem to decrease through time. No true examples of "Chapeau de Gendarme" platforms exist throughout the sequence.

Another temporal trend is the reduction through time of the ILty, which is the percentage of Levallois blanks left unretouched. Because the actual percentage of Levallois production (as shown by the Levallois Index, IL) does not decrease in the same way, the reduction of the ILty is most probably a result of more of the original Levallois blanks being selected for retouching. In itself, then, the ILty is a reflection of the intensity of utilization

of the available lithic resources and ties into the interpretation of the increase in the frequency of heavily reduced scraper forms (see above).

Unfortunately, few faunal remains (twelve teeth and four identifible bones) were recovered from the Mousterian levels at Warwasi, and they are described by Turnbull (1975). They include *Equus hemionus, Ovis/Capra, Capra aegagrus, Sus scrofa,* and *Hyaena sp.* remains. In the absence of more adequate faunal remains, or sedimentological and palynological studies, there is little that can be said to place these industries in an environmental context or chronostratigraphic framework. Furthermore, there are no absolute dates for the material.

COMPARISONS WITH OTHER ZAGROS MOUSTERIAN ASSEMBLAGES

Mousterian industries have been found throughout the Zagros and immediately adjacent areas; they have mostly been described in a summary fashion (Garrod 1928, 1930; Mortensen 1974; Piperno 1972; Rosenberg 1988; Sadek-Koulos 1976; Smith 1986; Wright and Howe 1951; Young and Smith 1966). Similar industries seem to extend into the Taurus region of Antalya (Minzoni-Déroche and Yalçinkaya 1985; see Yalçinkaya et al., this volume).

The Zagros Mousterian assemblage that can most directly be compared with Warwasi is that of the Bisitun Cave, excavated by Coon in 1949 (see Dibble 1984b). Published type frequencies are also available for Shanidar, Layer D (Akazawa 1975; Skinner 1965), Houmian (Bewley 1984; McBurney 1970), and Hazar Merd, Layer C (Skinner 1965), and previously unpublished counts from Kunji have kindly been made available us by Speth and Baumler.[4] Cumulative graphs of these assemblages in relation to the combined lower three units (A-C) from Warwasi are shown in Figure 2.8. Comparative typological and technological data are presented in Table 2.9.

Skinner (1965) defined his Group A (Zagros) as having negligible Levallois technique, high occurrences of platform faceting, discoidal core technique prevalent, moderate amounts of Quina retouch, high percentages of points, high Racloir Indices, and few backed blades and denticulates. In fact, the data presented here seem to show a much greater heterogeneity among these industries than was first suggested by him.

There is, for example, a great deal of variability in terms of the frequency of Levallois, ranging from an IL of 55.8 at Bisitun to virtually zero at Shanidar. The Bisitun data should not be trusted, however, because they reflect some bias of what was saved from the excavation. But other troubling sources of variability in this measure still remain. First is the problem of the definition and recogniton of Levallois (see endnote 4, above; Akazawa 1975:8). For example, the criteria used by Skinner and Akazawa do not agree with our own (see Dibble 1984b:30-32), because for both of these authors Levallois flakes must show evidence of radial preparation. Given that much of the Zagros Mousterian assemblages emphasize uni- and bidirectional preparation, few of these flakes could be recognized as Levallois. As Bordes (1980) noted, however, this criterion should not be overemphasized, as other kinds of Levallois preparation do exist in different regions. In fact, most of the highly Levallois "Layer D" type Mousterian from the Levant is also nonradial in its preparation (Crew 1976; Volkman 1983). Thus, a significant aspect of the variability in Levallois could be simply "intertypologist" in origin.

A second problem area among typologists concerns the Mousterian points vis-à-vis the convergent scrapers, which, as Bordes himself notes (1961), is a somewhat subjective distinction. Clearly, the Zagros Mousterian is characterized by a high frequency of converging pieces. The problem is that these two type classes are located relatively far from each other on the typelist, so that bias on the part of the typologist favoring one or the other class will result in major differences in the resulting cumulative diagrams. Thus, it seems that a major difference between Hazar Merd on the one hand, and the Mousterian of Warwasi and Bisitun on the other, is a question of the former's converging pieces being classified as points versus convergent scrapers. Although we have tried to be true to Bordes's own criteria for our classifications, admittedly we are a bit conservative owing to our belief that virtually all of the so-called points are, technologically and functionally, convergent scrapers and therefore are more often typed as such. Such an interpretation is supported, however, by an

analysis of breakage patterns at Bisitun and Warwasi (Holdaway 1989), by microwear studies of Mousterian assemblages in Europe (Beyries 1987, 1988; Anderson-Gerfaud 1981), and by statistical analysis (Dibble 1988), though there are opposing views (Rose Solecki 1992).

A significant potential source of typological variability, often overlooked, relates to postdepositional disturbances. At Warwasi, Bisitun, and Kunji there is a high degree of breakage in the material. During the excavation of Kunji it was observed to be extensively bioturbated owing to porcupine and small rodent activity (Speth 1971), and this could explain the high degree of breakage. However, it is not known if the same explanation might apply to Warwasi and Bisitun because the relevant sedimentological studies were not performed at the time of excavation to show postdepositional disturbances of the sediments. What is worth noting here is the degree to which such fragmentation affects the overall typological composition of the assemblage. Figure 2.9 displays the cumulative distribution of the essential counts of complete tools versus proximal, distal, and medial tool fragments. Since distal ends are critical for recognition of points or convergent scrapers, these types usually cannot be identified on proximal and medial fragments. Thus, if an industry that originally contained high frequencies of points and convergent scrapers were to suffer from signficant postdepositional breakage, the resulting assemblage would be biased in favor of more double scraper forms. Thus, the degree of breakage could be a factor, albeit a small one, contributing to inter-assemblage variability.

Other aspects of variability include the high frequencies of Upper Paleolithic types reported by Akazawa for Shanidar D and, to some extent, in Warwasi Unit D. In the case of the latter, given the use of arbitrary levels, the high frequencies may be due to mixture with the overlying Baradostian. Whether or not this explains the elevated Group III at Shanidar is not clear, especially because this site suffers from a significant degree of interobserver variability (Skinner versus Akazawa), although Solecki (1958) originally felt that there was no significant mixture between the Mousterian and Baradostian. Another anomaly is the higher occurrence at Houmian of naturally backed knives (Type 38) and divers (Type 62). The latter especially may reflect intertypologist variability. The presence of truncated-faceted pieces have not been reported from Shanidar, Hazar Merd, or Houmian, though this may well reflect the lack of recognition of those types at the time the analyses were undertaken.

All the assemblages are fairly laminar, though actual blade technique is rare. The shapes of the blanks are probably the most parsimonious reason why there are so few transverse scrapers in these assemblages, as continued resharpening would proceed more efficiently by retouching both edges. Likewise, the overall thinness of the blanks—mean thickness of retouched pieces is 6.9 mm at Houmian, 6.3 mm at Warwasi (levels JJ-CCC), and 6.5 mm at Bisitun—is probably responsible for the lower values of the Quina index.

One aspect of variability among these assemblages that may be more significant for prehistoric behavior is reflected in the amount of reduction of the scrapers. Figure 2.10 presents the index of the more reduced types (doubles, convergents, points) relative to the total number of scrapers, for each of the sites discussed so far. Because this index is computed only on the basis of scrapers and because Mousterian points are combined with the convergent forms, little intertypologist error should be expected. According to this interpretation of scraper typological variability, it seems that Houmian represents the least-reduced assemblage, while Bisitun, Shanidar, and Hazar Merd are among the most intensely utilized. It would be interesting to know if such a measure reflects other aspects of the environment (see Rolland 1977, 1981; Rolland and Dibble 1990; Dibble 1988; Dibble and Rolland 1992), though these data are not available. The groupings seen in Figure 2.10 are, of course, somewhat different from those apparent in the traditional cumulative diagrams presented in Figure 2.8.

There are, then, many sources of variability among these assemblages. One way to combine all of them and examine their effects simultaneously is through Principal Components Analysis. The components generated by this technique represent unique and noncorrelated combinations of the input variables that best account for variability in the data. Six variables were input, all based on the real (*versus* essential) counts: ILty, Group III (Upper Paleolithic elements), and the percentages of single scrapers, double scrapers, all convergent pieces (scrapers, points, limaces), and notches + denticulates. Using Systat, version 3, six principal components were then calculated. The standardized principal component coefficients (see Table 2.10) are a

measure of the contribution of each variable to a given Principal Component, with larger absolute values for one variable indicating a greater contribution relative to the other variables, and the sign (positive or negative) indicating the kind of relationship (positive or inverse, respectively). For these sites, the first component, which accounts for 47% of the variability, is pulled in a negative direction by the Group III and notches/denticulates, and pulled in a positive direction by all the scrapers; the second component appears to be ILty versus convergent pieces; the third is primarily a function of double scrapers, and so on.

Figure 2.11 presents graphs of the industries along the first three Principal Components, which together account for about 93% of the variability in these data. It is apparent from the upper graph that the first component results in a clear separation of Akazawa's counts of the Shanidar material, owing principally to his high numbers of Upper Paleolithic elements. This is a function of interobserver error. The second and third components, shown in the lower graph, reflect two things: the difference in Levallois and relative contributions of double and convergent scrapers. The first of these, Levallois, may also be a function of interobserver error, separating the Warwasi and Bisitun assemblages from the others. But in both of these series (Bisitun and Warwasi on the one hand, and the other sites on the other) the assemblages follow a line from the lower right to the upper left, which reflects the increasing proportions of double and convergent scraper types. This is perfectly in agreement with the results obtained earlier using a simple index of double and convergent forms relative to all scrapers (see Fig. 2.10).

In sum, there seem to be two major components of the interassemblage variability seen in the Zagros Mousterian. The first, unfortunately, relates to interobserver variability in the classification of the the industries and thus does not have significance for understanding prehistoric behavior. The second appears to reflect varying intensities of utilization of lithic resources as more blanks are transformed into double, and eventually convergent, scrapers, through repeated resharpening. The ultimate cause of the variability in reduction is unknown at this time. However, it is not unreasonable to suggest that it is related to intensity of occupation, quality and availability of raw materials, and mobility, as has been suggested for the Mousterian in general (Rolland and Dibble 1990; Dibble and Rolland 1992).

COMPARISONS WITH LEVANTINE ASSEMBLAGES

It is beyond the scope of this paper to make detailed comparisons of the Zagros Mousterian with Middle Paleolithic industries from many other areas. It is of interest, however, to contrast some of the major typological differences between this region and the adjacent Levant. Figure 2.12 shows three examples of Levantine Mousterian (Bed 66 and "Unit I" from Tabun, located on the western edge of Mt. Carmel; and Rosh Ein Mor in the Negev Desert) and one example of the Yabrudian "facies" of the Mugharan Tradition, as defined by Jelinek (1982a), also from Tabun (Bed 75S1). Note that these diagrams in Figure 2.12 are based on essential counts; otherwise the extremely high percentage of Levallois flakes and points in the Levantine Mousterian (ILty usually ranging from 55.0 to 65.0) would mask the typological differences of interest here.

The Levantine Mousterian is characterized as having relatively few retouched tools (see Jelinek 1982b: Fig. 2.2; Marks 1988: Table 16.1). If the naturally backed knives are not considered, because they are not retouched, the most important typological group is composed of the single scrapers. Characteristically, there is little reduction of these into double, convergent, or transverse forms, which would be expected given the low intensity of utilization in general. Thus, the cumulative diagrams of these industries tend to be very flat across the range of types 12-24.

The stratigraphically earlier Yabrudian has a much higher component of retouched tools, again mostly scrapers, and very little Levallois. In these aspects it is much more like the Zagros Mousterian. Typical for the Yabrudian, however, is a high percentage of transverse and *déjeté* scrapers (types 21-24), and relatively fewer points, and double and normal convergent scrapers. Thus, the cumulative diagram for this industry tends to be markedly concave across the range of scraper types. The transverse scraper types still reflect a higher intensity of utilization of their lithic resources through resharpening of the edges. But the specific reduction sequence that they followed is quite

different from that seen in the Zagros, and more similar to the pattern that occurs among the Quina Mousterian of western Europe. As discussed in Dibble (1991a), the choice of which reduction sequence was followed is probably a reflection of the size and shape of the blanks: thick, broad flakes are more efficiently resharpened (in terms of maintaining the longest retouched edge) by reworking a single edge, whereas longer, thinner blanks are best resharpened from both sides. Such thick blanks are, in fact, a feature of the Yabrudian and contrast markedly with the longer and thinner blanks seen in the Zagros. Thus, blank shape is the explanation for the differences in scraper typology between the Yabrudian and the Zagros Mousterian. In fact, it is interesting that the highly laminar Zagros industries are typologically similar to the French Ferrassie Mousterian. Thus, as argued by Dibble (1991a), the typological convergences of the Zagros and Ferrassie on the one hand, and the Yabrudian and Quina on the other, are largely explained by blank shape. This further suggests that the typology of scrapers is not a particularly useful stylistic marker.

Nonetheless, it is clear that the Zagros industries are quite distinct from those in the Levant, and in ways that were originally noted by Skinner (1965). The main distinctions include the much lower frequencies of Levallois in the Zagros and an almost total emphasis on double and convergent scraper forms there instead of the transverse and déjeté forms common in the Yabrudian. Although the latter typological difference may be largely explainable in terms of the differences in blank forms, the explanation for the difference in technology producing those differently shaped blanks is not known. Possibly it is in part due to differences in raw material, but it may also have to do with other (stylistic?) factors. The extent to which these traits carry over into Turkey, and perhaps into southeastern Europe, is important to determine (see Yalçinkaya et al., this volume).

CONCLUSIONS

This review of the Zagros Mousterian has emphasized the typological and technological aspects of these industries, primarily because that is what is available. Faunal remains from these sites are poor, and usually the most that can be done is to present simple counts (Turnbull 1975; Coon 1951: Table 3; Levine in Bewley 1984:25-29). At this time, no zooarchaeological analyses have been done (see Evins 1982). Unfortunately, sedimentological, palynological, and chronological data are also virtually nonexistent across the region. Probably the most comprehensive set of such data is available for Houmian, which is suggested to date to the Brørup interstadial (Leroi-Gourhan 1981), but without comparative data not much can be done at this time to place the industry in a regional chrono-stratigraphic framework. Such frameworks are desperately needed for this region. There is also a great deal of what appears to be interobserver error in the reporting of these assemblages. Thus, we are far from a complete understanding of these industries and even further from understanding the behavior of the prehistoric peoples in their environmental setting.

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NOTES

1. This index is a modification of the one presented in Dibble (1988), in which only the convergent and transverse scrapers were used in the numerator to reflect the most reduced scrapers. However, given the very low frequency of transverse scrapers here (a reflection of the laminar nature of the industry; see below), and the fact that many double scrapers (e.g., the so-called rods), seem to reflect a high degree of reduction, the frequency of double scrapers is included in the numerator so that higher frequencies of them will make an assemblage appear more reduced.

2. At Bisitun, unretouched flakes were not signficantly smaller than the retouched tools (Dibble 1984b: Table 7). This finding probably is due to the original excavator's having discarded most of the smaller flakes, thus elevating the averages of those flakes that were available for study.

3. Specialists who have examined the Warwasi and Bisitun collections at The University Museum have, among themselves, expressed extremely differing opinions as to the Levallois nature of these industries. This suggests, as does the study by M. Perpère (1986), a very real problem concerning the definition and attribution of Levallois that should be addressed by prehistorians in the near future (see also Boëda 1982, 1988).

4. Two excavations at Kunji have been made, one by F. Hole (Yale) in 1963, the other by J. Speth (University of Michigan) in 1971. The series here comes from the latter. The actual classification of the material presented here was done by M. Baumler (Montana State Historical Preservation Office) and was made available to us in 1986. See also Baumler and Speth, this volume.

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TABLE 2.1. Type counts for each of the four grouped units from Warwasi.

Type #	Type	Unit A (WW-CCC)	Unit B (SS-VV)	Unit C (NN-RR)	Unit D (JJ-MM)
1	Typical Levallois flake	19	4	2	1
2	Atypical Levallois flake	19	17	3	4
3	Levallois point	2	2	1	2
5	Pseudo-Levallois point	0	0	0	1
6	Mousterian point	3	13	11	5
7	Elongated Mousterian point	3	4	4	2
9	Single straight side-scraper	23	61	47	14
10	Single convex side-scraper	27	46	35	11
11	Single concave side-scraper	10	12	9	3
12	Double straight side-scraper	3	20	17	6
13	Double straight-convex side-scraper	10	18	8	8
14	Double straight-concave side-scraper	5	2	6	6
15	Double convex side-scraper	2	8	8	2
16	Double concave side-scraper	0	4	4	4
17	Double concave-convex side-scraper	5	11	6	6
18	Convergent straight scraper	2	4	6	3
19	Convergent convex scrapers	10	7	8	6
20	Convergent concave scraper	4	5	1	1
21	Déjeté scrapers	1	4	1	2
22	Straight transverse scraper	0	0	1	1
23	Convex transverse scrapers	1	1	1	5
25	Side-scraper on interiors	3	4	3	3
27	Side-scrapers with thinned back	1	2	3	3
29	Alternate retouched side-scraper	0	2	2	1
30	Typical end-scrapers	0	1	1	2
31	Atypical end-scrapers	1	2	2	1
32	Typical burins	6	7	9	6
33	Atypical burins	0	1	1	1
34	Typical percoirs	1	1	1	2
36	Typical backed knives	0	0	0	3
38	Naturally backed knives	4	1	7	7
39	Raclettes	0	0	1	1
40	Truncated flakes and blade	4	6	10	1
42	Notches	4	11	9	7
43	Denticulates	12	20	23	12
44	Alternate retouched becs	0	0	0	1
45	Irregular retouch on interior surface	0	0	2	4
46-49	Abrupt and alternate retouch	1	1	10	5
50	Bifacial retouch	0	0	1	1
51	Tayac points	0	1	1	1
54	End-notched flakes	5	5	1	1
62	Divers	0	1	2	2
64	Truncated-faceted pieces	0	10	10	3

Table 2.2. Real and essential typological indices, counts, and percentage of truncated-faceted pieces for each of the Warwasi units. Percent of reduced scrapers calculated as frequency of double, convergent, and transverse scrapers relative to all scrapers (see text).

COMPLETE COUNT

Unit	ILty	IR	Iau	I	II	III	IV	N
D	4.43	53.80	0.02	4.43	58.86	10.13	7.59	158
C	9.34	57.44	0.00	9.34	62.63	8.30	7.96	289
B	15.63	62.24	0.00	15.63	67.26	5.31	5.90	339
A	20.94	56.02	0.00	20.94	59.16	6.28	6.28	191

ESSENTIAL COUNT

	% Truncated-	Reduced						
Unit	IR	Iau	II	III	IV	IQ	Faceted	Scrapers
D	60.28	0.02	65.96	11.35	8.51	3.7	7.91	.670
C	66.67	0.00	72.69	9.64	9.24	1.2	14.97	.473
B	74.04	0.00	80.28	6.32	7.02	6.2	15.14	.459
A	71.33	0.00	75.33	8.00	8.00	6.5	8.00	.449

TABLE 2.3. Averages of metric observations and retouch intensity by scraper class, for levels JJ - CCC. Retouch intensity coded as 1 (light), 2 (normal), 3 (heavy), and 4 (Quina or Demi-Quina). Single scrapers include Types 9-11; double scrapers are Types 12-17; convergent forms included Types 6-8 and 18-21.

SCRAPER CLASS	Length	Maximum Width	Thickness	Flake/Platform Ratio	Retouch Intensity
Single					
Mean	52.40	29.36	7.18	26.42	1.45
S.D.	17.16	9.93	2.89	29.53	0.61
N	70	69	70	63	292
Double					
Mean	53.17	21.98	5.88	23.06	1.82
S.D.	16.46	6.25	2.38	16.48	0.75
N	24	24	24	20	139
Convergent					
Mean	50.28	23.54	6.36	14.26	2.01
S.D.	17.28	7.47	2.65	12.12	0.79
N	57	57	57	48	98

TABLE 2.4. Average thickness of truncated-faceted pieces compared with other retouched tools for levels JJ-CCC at Warwasi and the entire Mousterian assemblage at Bisitun. At both sites these differences are significant (Warwasi: t=2.51, df=40.3, P=.016; Bisitun: t=5.79, df=500, P<.001).

	Warwasi	Bisitun
Truncated-faceted		
Mean	7.86	8.15
S.D.	1.74	2.51
N	24	71
Non-truncated-faceted		
Mean	6.83	6.48
S.D.	2.88	2.19
N	197	431

TABLE 2.5. Association between truncated-faceting and various tool classes for levels JJ-CCC at Warwasi (X2=12.78, df=5, P=.025, Phi2=.12). Numbers in parentheses show the column percentages. The low measure of association, Phi2, which can vary from 0 (no association) to 1 (complete association), shows that, while statistically significant, the relationship is not particularly strong.

	TRUNCATED-FACETING	
	Absent	Present
Single scrapers	276 (40.06)	22 (30.14)
Double scrapers	132 (19.16)	13 (17.81)
Convergent scrapers	61 (8.85)	3 (4.11)
Point	41 (5.95)	4 (5.48)
Notch/denticulate	80 (11.61)	18 (24.66)
Other tool	99 (14.37)	13 (17.81)
Total	689 (100.00)	73 (100.00)

TABLE 2.6. Averages of major dimensions of tools, flakes, and cores, and t-test comparisons of the tools and flakes from levels JJ-CCC. Tools include all the Bordes essential types except type 38, which here is considered a flake.

	Length	Width	Maximum width	Thickness	Platform area
Retouched tools					
Mean	45.46	23.13	25.24	6.94	108.10
S.D.	17.06	8.31	9.09	2.76	97.15
N	242	241	239	242	292
Unretouched flakes					
Mean	37.83	20.84	23.29	5.54	75.99
S.D.	12.09	7.95	8.30	2.84	85.68
N	655	655	650	656	638
Comparison of tools and flakes					
T =	6.38	3.71	2.90	6.66	4.84
df =	334	409.8	392.7	440.8	505.6
P <	.0001	.0001	.004	.0001	.0001
Cores					
Mean	42.63		34.93	18.43	
S.D.	16.49		15.43	10.43	
N	144		144	144	

TABLE 2.7. Average thickness of scrapers with light or normal retouch compared with those exhibiting heavy and stepped (Quina or Demi-Quina) retouch (t=2.668, df=148, P=.008). Levels JJ-CCC.

	Light and normal	Heavy and stepped
Mean	6.38	7.88
S.D.	2.65	2.95
N	121	29

TABLE 2.8. Exterior scar patterns (semi- and full radial as defined in Baumler 1988) and technological indices for Warwasi by stratigraphic unit. The technological characteristics of Unit D are still under study.

	Scar Preparation				Technological indices				
	Semi- and full								% True
Unit	Uni-	Bi-	Radial	Plain	IL	IF	IFs	Ilam	Blades
A	46.6	20.9	18.5	13.9	13.1	50.2	40.6	43.2	6.3
B	37.6	25.0	24.3	13.1	7.4	53.8	39.6	45.3	7.5
C	37.6	18.5	27.5	16.3	7.5	45.9	30.8	38.0	2.0

TABLE 2.9. Typological and technological data from other Zagros Mousterian assemblages.

INDICES	HOUMIAN	KUNJI	SHANIDAR (Akazawa)	SHANIDAR (Skinner)	HAZAR	MERD	BISITUN
ILty	10.97		8.62	0.75	1.05[1]	1.64[1]	10.63
IR	34.19[1]		62.07	24.74	59.20	53.28[1]	68.30
Iau	0.00		0.01	0.03	0.00	0.00	0.01
IQ	0.00		8.62	N/A	4.90	7.80	19.46
I	12.90		8.62	0.75	1.75	1.64[1]	10.72
II	43.23		69.94	38.90	79.40	92.62	73.29
III	7.10		4.74	19.37[2]	8.58[1]	3.28	6.56
IV	4.52		1.72	6.26[1]	2.50	1.64[1]	3.33
IL	2.30		10.09	N/A	3.00	7.00	55.80[3]
Ilam	22.90		N/A	N/A	12.70	20.30	55.10
IF	23.70		N/A	N/A	43.20	47.10	64.71

[1] Recomputed on basis of published type counts, but differs from published index.
[2] Published index did not include truncations (type 40).
[3] Highly inflated due to disposal of non-Levallois, unretouched flakes at time of excavation.

TABLE 2.10. Results of Principal Components Analysis, indicating percentage of variance explained by each component, and relative contribution to each component by the input variables (ignoring the sign). See text.

Component Number	1	2	3	4	5	6
	Percentage Explained Variance					
	47.19	32.39	12.90	3.49	2.73	1.27
	Standardized Principal Component Coefficients					
VARIABLE						
ILty	0.225	0.918	-0.152	-0.025	0.287	0.032
Single	0.872	0.232	-0.269	0.299	-0.131	0.078
Double	0.562	0.189	0.803	0.023	0.003	0.051
Convergent	0.434	-0.848	0.021	0.170	0.241	0.074
Upper Paleolithic	-0.931	-0.256	0.056	0.136	0.078	0.201
Denticulates	-0.805	0.478	0.174	0.268	-0.020	-0.143

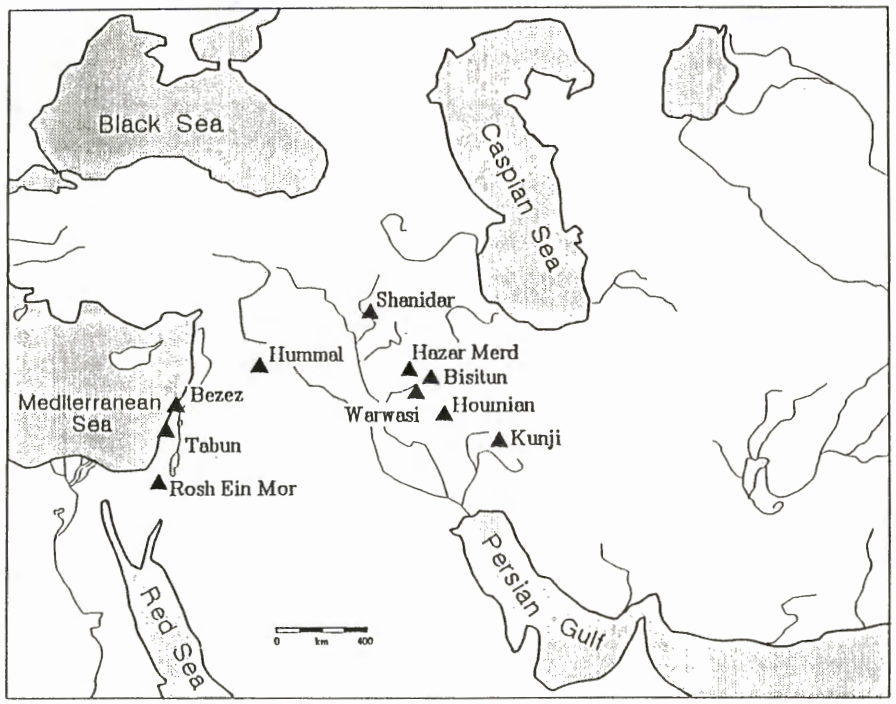


Figure 2.1. Map of selected Near Eastern Mousterian sites.

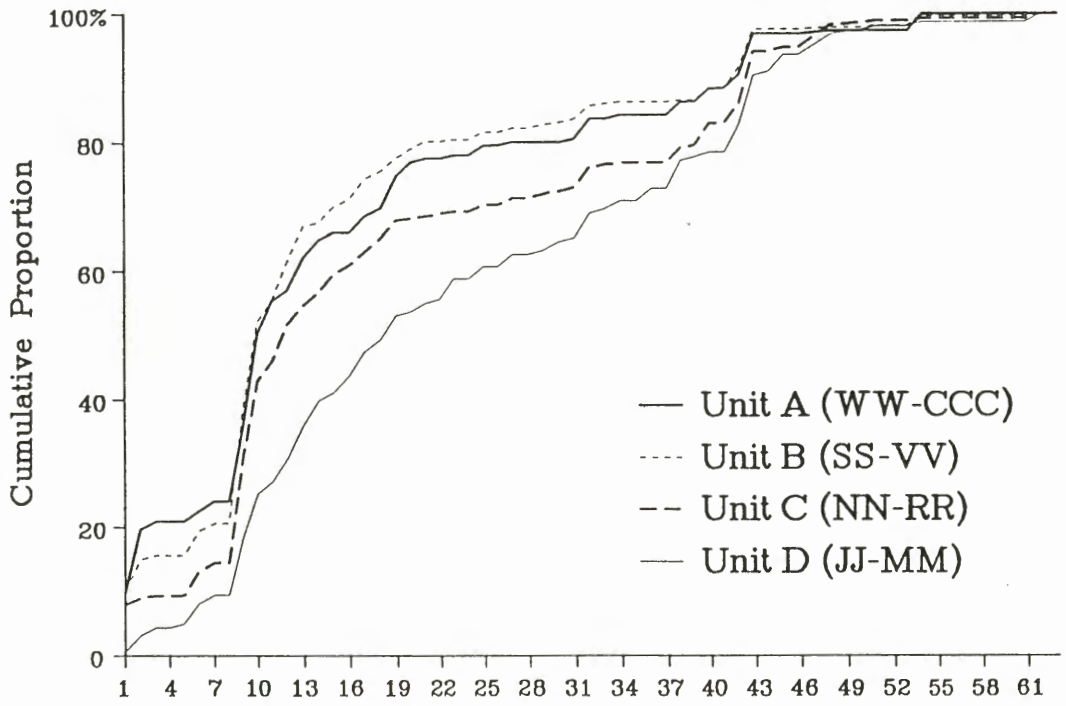


Figure 2.2. Cumulative diagram of Bordian types (Bordes 1961) for each of the arbitrary stratigraphic units defined for Warwasi.

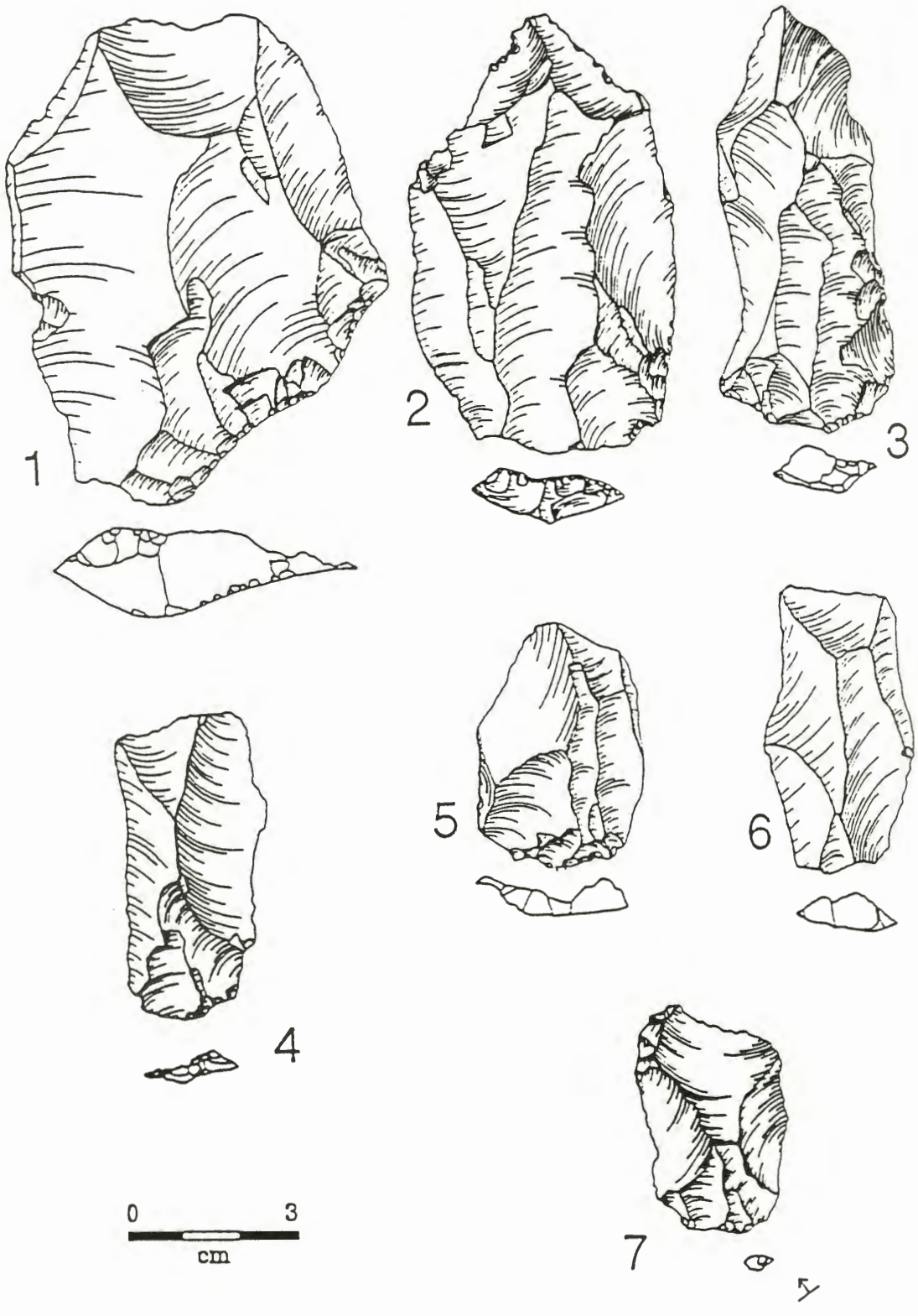


Figure 2.3. 1-7: typical Levallois flakes.

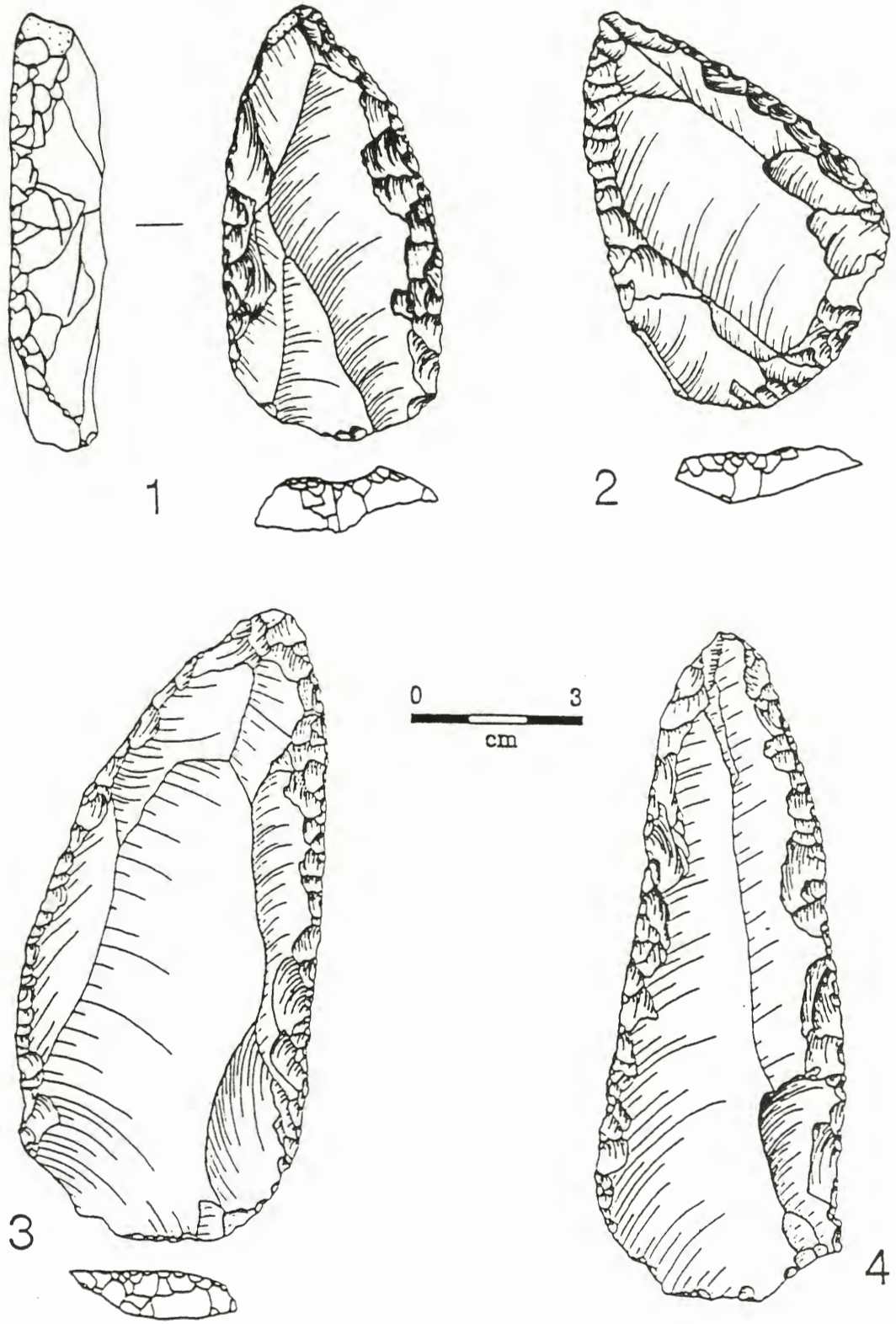


Figure 2.4. 1-4: convergent scrapers.

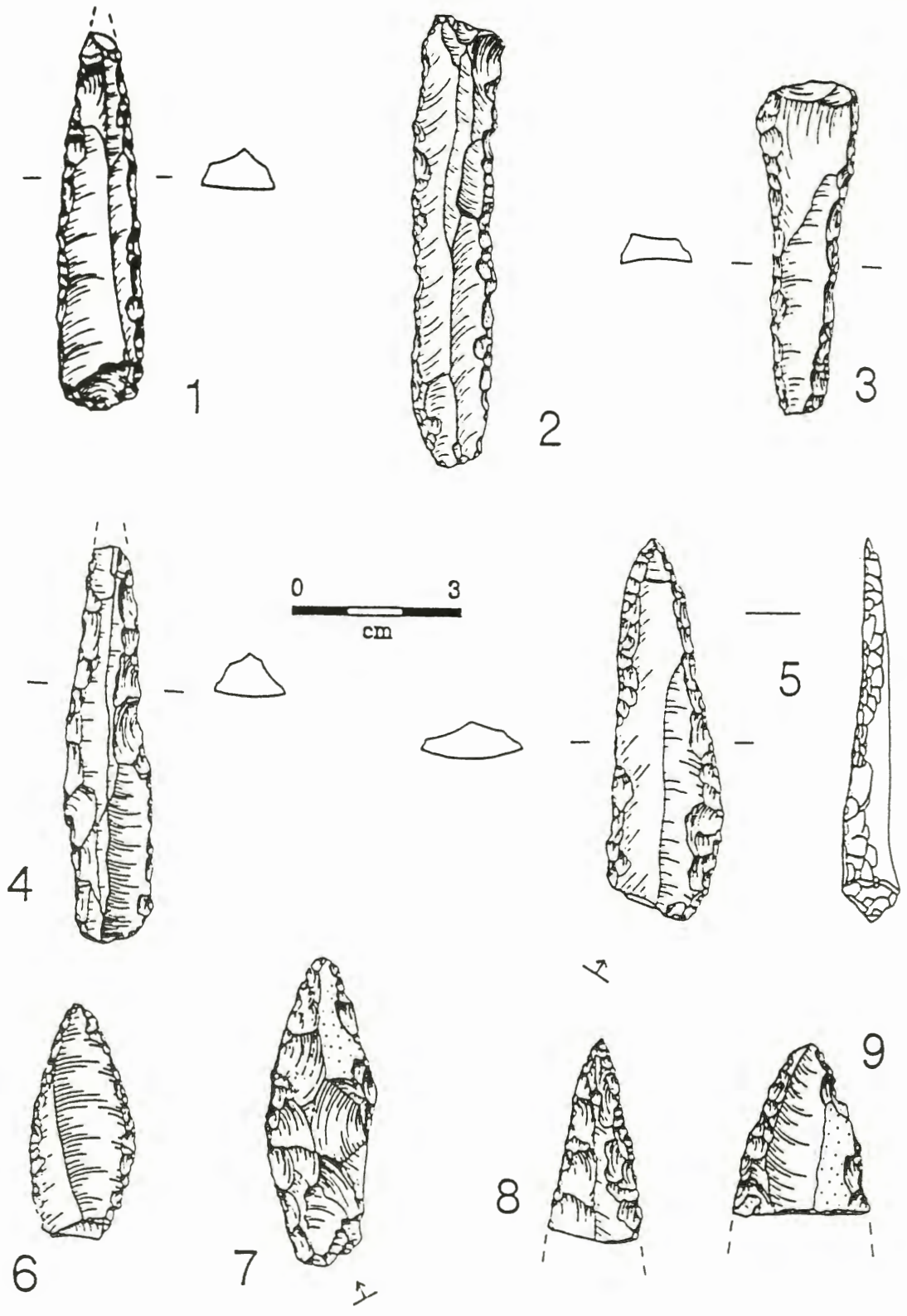


Figure 2.5. *1, 5-7: convergent scrapers/Mousterian points; 2-4: double scrapers ("rods"); 8-9: distal fragments from convergent scrapers.*

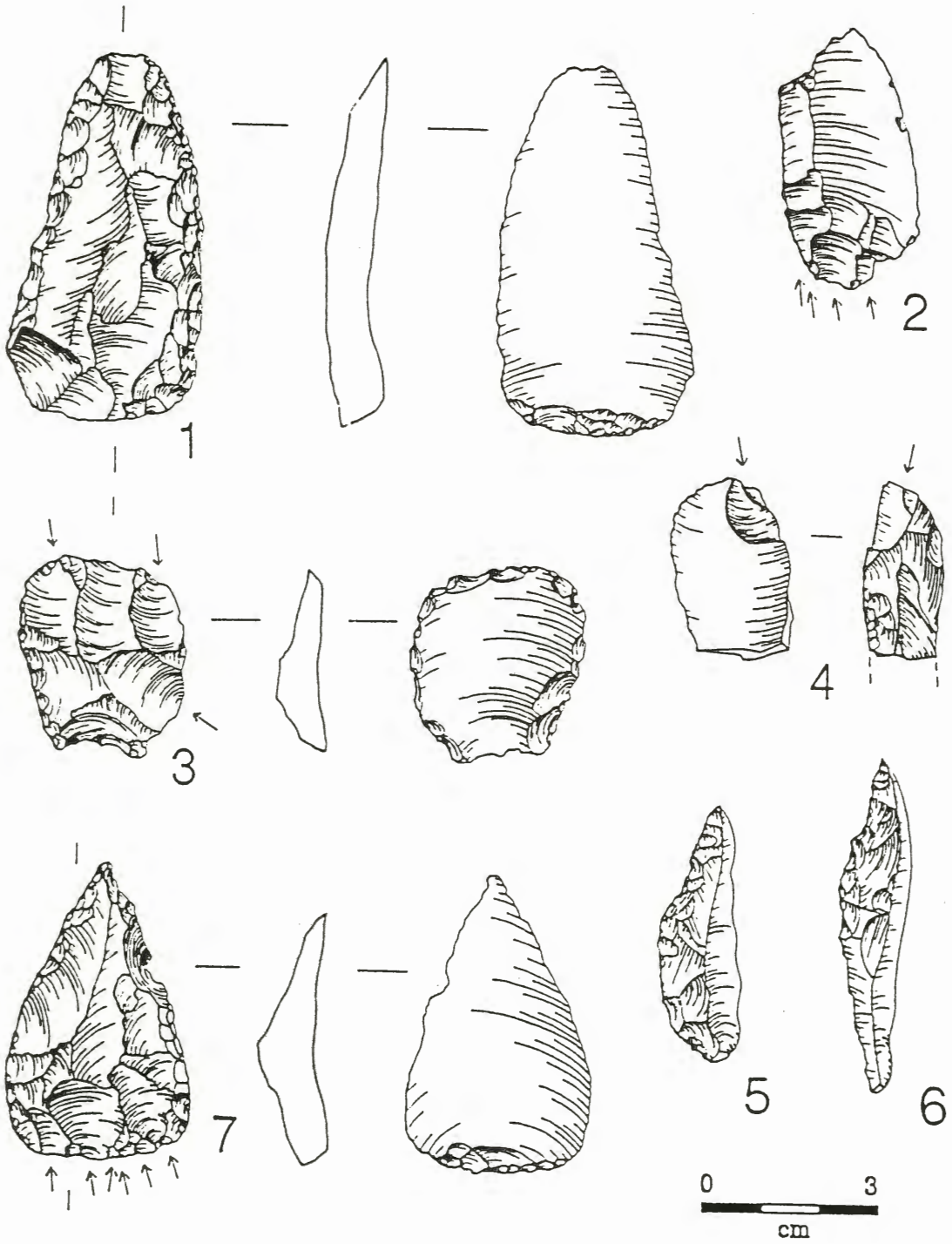


Figure 2.6. *1: double scraper with proximal truncation, possibly as initial preparation for truncated-faceting; 2, 4: burins, which may also reflect removal of original scraper edge; 3: truncated-faceted piece on small flake; 5-6: burin spalls or scraper rejuvenation flakes; 7: convergent scraper with truncated-faceting.*

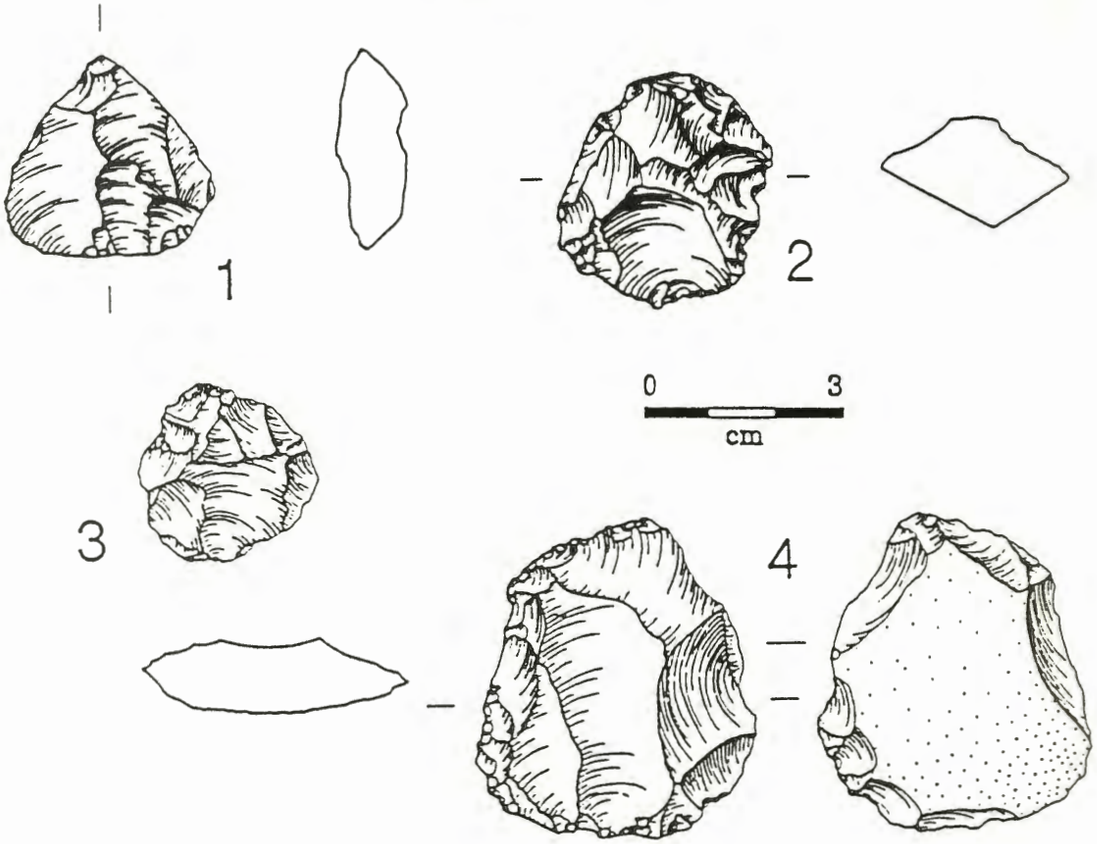


Figure 2.7. 1-3: radial flake cores; 4: Levallois flake core.

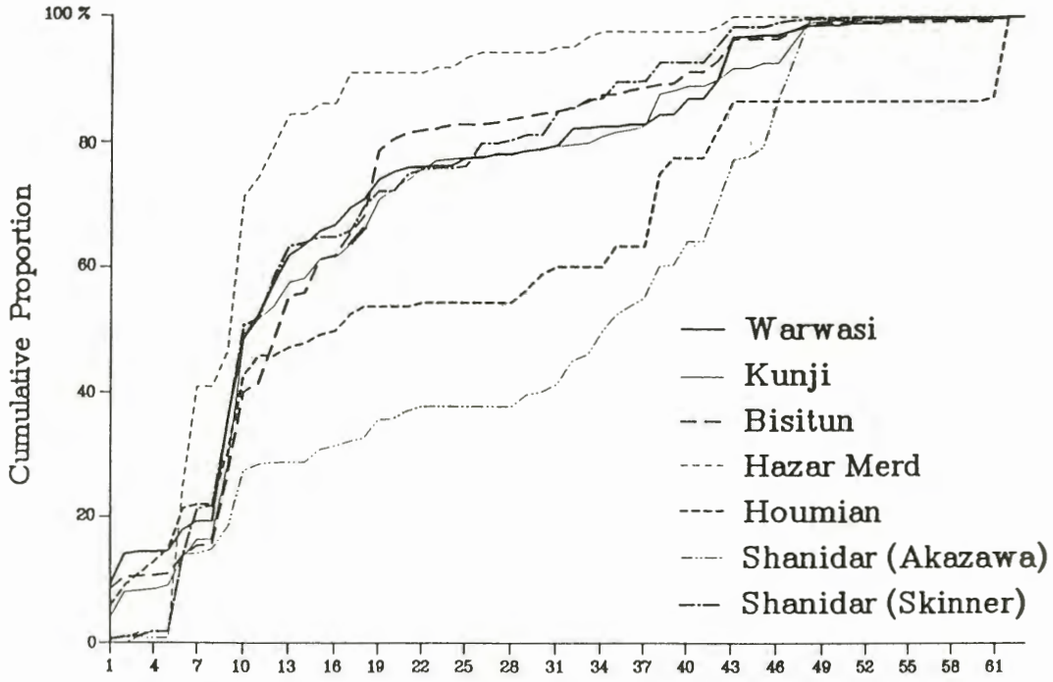


Figure 2.8. Cumulative diagrams of Zagros Mousterian assemblages.

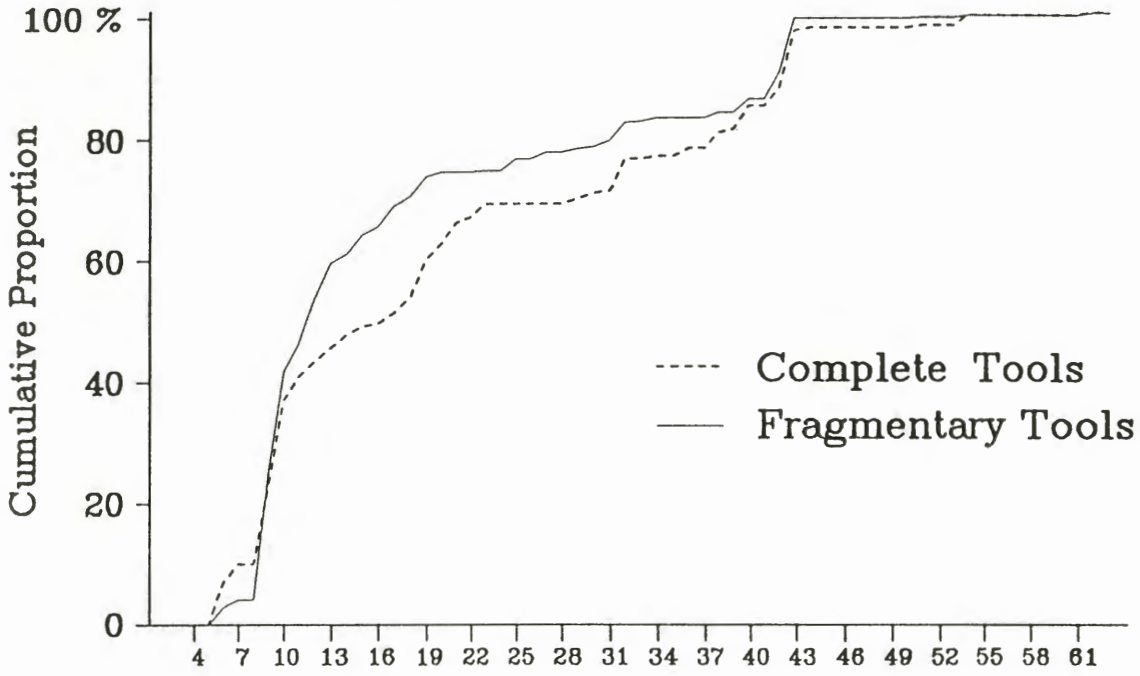


Figure 2.9. *Effects of fragmentation on assemblage composition. Each line in the diagram corresponds to different classes of whole and fragmented pieces, combining all the levels from JJ to CCC.*

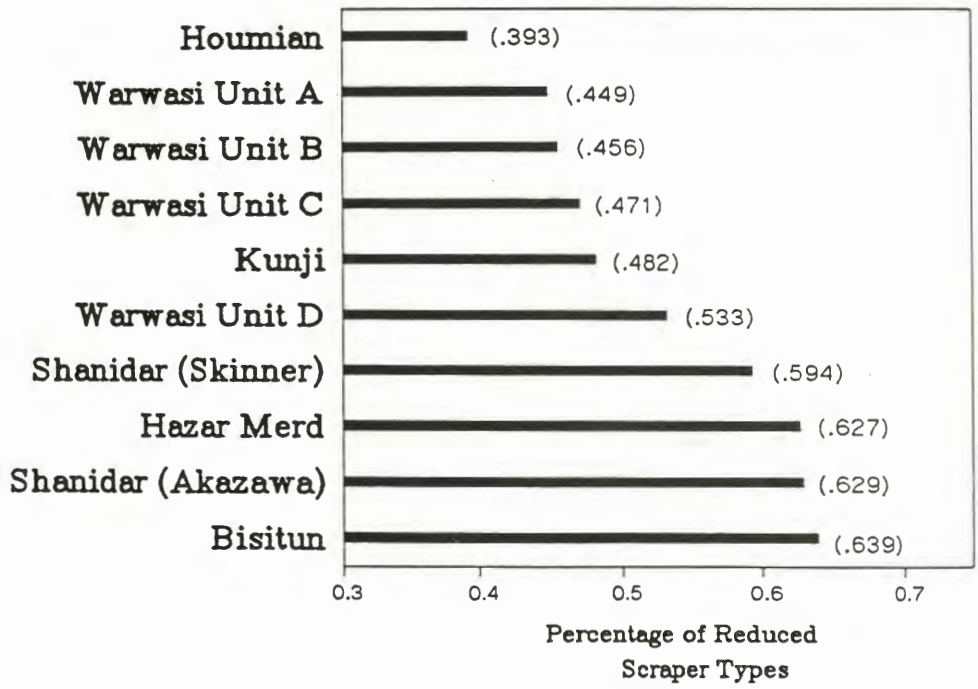
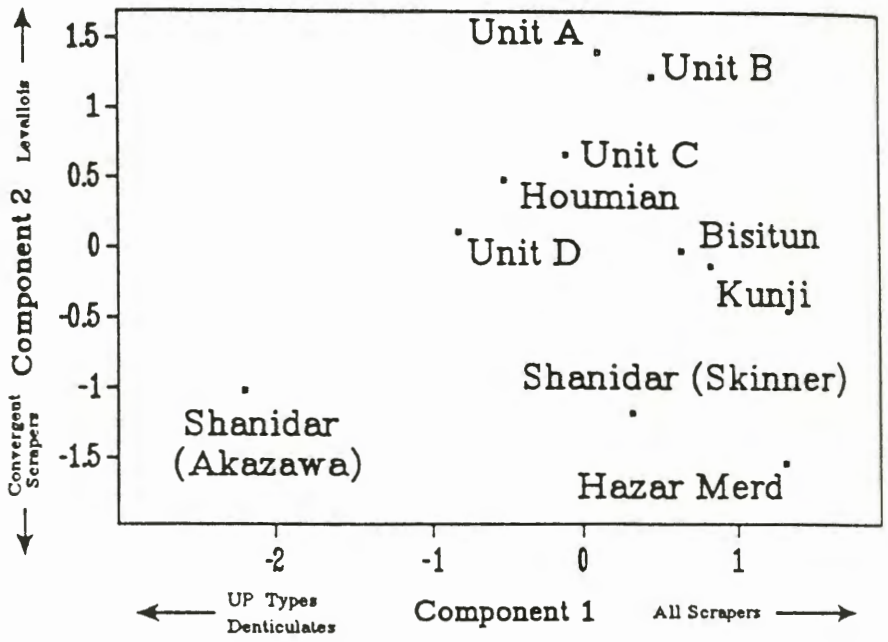


Figure 2.10. *Index of scraper reduction (points, double and convergent scrapers relative to all scrapers) for Zagros Mousterian assemblages discussed in text.*

A



B

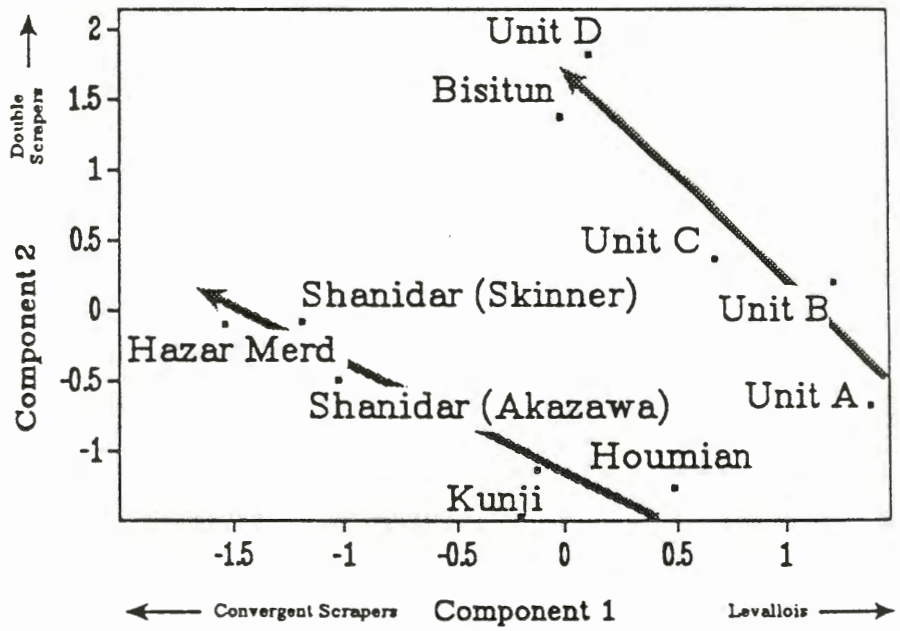


Figure 2.11. *Scatter diagrams of the First and Second Principal Components, or Factors (upper), and Second and Third Principal Components (lower), computed for ten assemblages of Zagros Mousterian.*

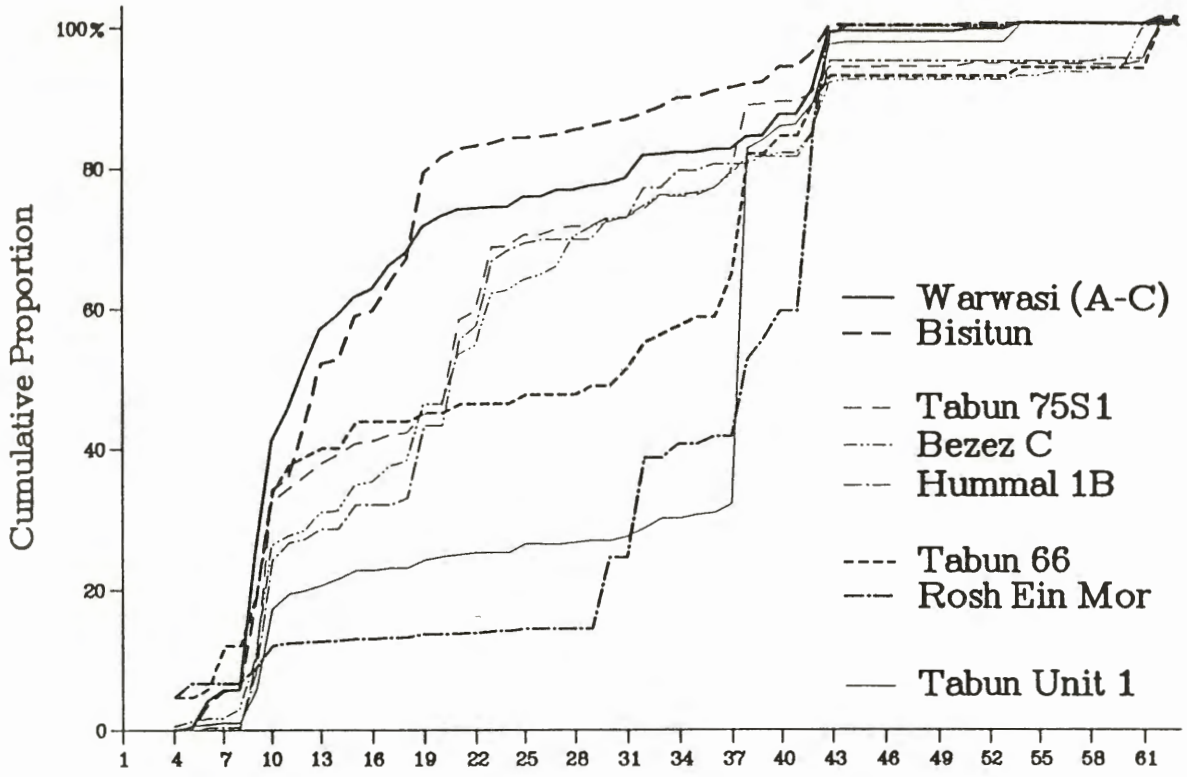


Figure 2.12. Cumulative diagrams of selected Levantine assemblages (from Dibble 1981; Crew 1976), Bisitun, and Warwasi.

3

The Excavations at Karain Cave, Southwestern Turkey: An Interim Report

Isin Yalçinkaya, Marcel Otte, Ofer Bar-Yosef, Janusz Kozlowski, Jean Marc Léotard, and Harun Taskiran

The current debate concerning the origins of modern humans and the fate of the Neanderthals has created great interest in the many excavations of the Middle Paleolithic age. Sites across the Old World, and especially between Africa and Western Europe, became the targets for new field and dating projects. Along the presumed route of human migration from Western Asia to Europe or from Southeastern Europe eastward, Turkey occupies the geographic crossroads. But the prehistoric stratigraphic-cultural sequence of this region, especially for the late Middle and Upper Pleistocene, has not yet been established. The uncovering and dating of the Middle Paleolithic sequence of southwestern Turkey is therefore of prime importance. The excavations at the cave of Karain are aimed at achieving this goal as well as establishing the cultural stratigraphy of the region.

The cave is located in the mountainous ridges known as Katran that dominate the vast flat plain shaped by marine ingressions (Fig. 3.1). Numerous caves and rockshelters reflect the intensive karstic activities during the Pleistocene. Copious springs are abundant, and in this calcareous region the precipitation of carbonates is an ongoing process.

The complex of cavities known as Karain (Black Cave) opens in a rocky cliff with a southern orientation. The cavities or large chambers are separated in a few cases by stalagmitic crusts that form massive walls. Each chamber is designated by a letter (Fig. 3.2), given by the original discoverer and excavator of the cave, the late professor Kökten, who held the chair of Prehistory in Ankara University from 1946 to 1973 (Kökten 1947:232, 1964). The excavations were renewed by his successor (I. Y.), first in collaboration with the University of Tübingen (Yalçinkaya 1987, 1988a, b, 1989a, b; Albrecht 1988a, b; Berke 1988) and, since 1989, with the current team.

The main excavations were conducted in chambers E and B (see Fig. 3.2). The recently exposed section in chamber B contains layers of Epipaleolithic age, indicated by the bladelet-dominated industry and by the radiocarbon dates (Albrecht 1988a, b). The lowermost excavated unit produced Mousterian pieces, but its correlation with the thick Mousterian layers in chamber E is not yet established.

The longest depositional record in chamber E (named Kökten's Hall) was revealed by the early excavations of Kökten, and it is in this part of Karain Cave that the main efforts are currently concentrated (Fig. 3.3).

The deposits in chamber E have been accumulated and altered by the activities of various biogenic and anthropogenic agencies that alternately played important roles. The sediments include siltic and clayey layers, small calcareous rock fragments, occurring mainly near the walls, stalagmitic crusts, and washed-in colluvial elements, as well as brought-in anthropogenic elements such as lithics and animal bones, the remains of hyena dens and microfauna from the deterioration of owls' pellets. A complex array of processes has intervened in the modification of the deposits, such as chemical alteration and erosion by flowing water. Sedimentological analyses that will enable us to identify the various processes and their sequence are underway. Preliminary micro-

morphological analysis indicates that intermittent occupation by humans and hyenas was one of the major agencies responsible for a large portion of the biogenic remains (P. Goldberg, personal communication).

One of the most impressive features of the Karain deposits are the thick carbonate layers that have accumulated in a series of massive layers, with an initial dip sloping from the outer face of the cliff toward the eastern wall of chamber E. Most of the archaeological materials had accumulated only in the central part of this chamber and toward its eastern wall. Bones and lithics are widely dispersed in this area.

In order to facilitate the identification of the various layers within the complex stratigraphy of chamber E, we subdivided the entire sequence into a series of larger units (Roman numerals) and a series of layers within each unit (Arabic numbers) (Fig. 3.3). Although it is possible to correlate and follow the distribution of the main units across the remaining deposits, many of the layers are of lenticular appearance and can be identified only locally. In addition, detailed correlations are hampered by the major excavations carried out by Kökten, which separated the upper part of the central area (Örnek Blok; on the left side of Fig. 3.3) from the eastern section. The calcitic formations play a particular role in the sequence. First, they are used as marker beds because of their quasi-horizontal formation across chamber E. Second, these successive stalagmitic accumulations will serve as a basis for dating by various techniques.

The archaeological excavations and the field observations indicate that the cave was filled in during a very long period, punctuated by several breaks in the aggradational process. Today the deposits almost reach the ceiling.

In the course of the earlier phase of the excavations, Kökten dug a major trench, sounding 10 m deep, through the carbonate deposits leading to chamber E and the area near the western and northern walls. He left a columnar section at the center of the cave ("berme centrale," or Örnek Blok). This section, as well as the unexcavated portion near the eastern wall, preserves the entire original sequence of the cave.

In 1985 the new series of excavations began with the removal of the brecciated top layers and a cleaning of the west profile, which was studied in detail by H. Laville (Yalçinkaya 1988a:262). In the following years the excavations continued in both the central area and the eastern sector (see Figs. 3.2 and 3).

The excavation field techniques include the digging of arbitrary archaeological horizons, each 10 cm thick (marked as AH in the field and CH in Figs. 3.4-3.12), through the geological layers. All sediments are dry-sieved and wet-sieved through a mesh of 1 mm. The residual sediment is dried and all the smallest lithic chips and microfauna are hand-picked in the course of the summer season.

The uppermost archaeological units in the central area (Örnek Blok), which average 30 cm thick and are hardly cemented, contain an Epipaleolithic industry with retouched and backed bladelets, small end-scrapers, end-scrapers on retouched blades, and thick end-scrapers, as well as cores and debitage. This layer dips to the east but is thinly represented in the eastern section. In comparison to the dated deposits in chamber B, where a similar industry was uncovered, it is clear that this assemblage is only 11-14,000 years old. A few Mousterian elements found in this layer are undoubtedly the result of a slight natural mixture. Given the proximity of this layer to the cave's roof it is clear that chamber E was not habitable during the Epipaleolithic. It is possible that this layer resulted from the chamber's having been used as a dumping zone or that this material was washed in from chamber B. When this top layer is removed, it becomes clear that the cave was much more spacious and open during Mousterian times.

Although the break between the Epipaleolithic and Mousterian layers is not always visible to the naked eye, the change between the two different industries is abrupt. The studied and reported sequence below the Epipaleolithic layer contains to date only Mousterian assemblages (to be described below in some detail), recovered from deposits of various sedimentological nature. The stalagmitic layers (I 6,7) that are at the base of the stratigraphy of the studied central area (Örnek Blok; Fig. 3) resemble similar phenomena in European caves where impressive accumulations of speleothems are dated to the Last Interglacial (Isotope Stage 5e). However, TL and ESR dates are awaited before the Mousterian assemblages reported here can be securely placed in an established chronology. Additional sedimentary units, which lie below the upper one, seem to have been the result of previous climatic cycles.

The Mousterian deposits contain numerous animal bones including rich microfaunal collections

and mollusks. All these remains, as well as the palynological record of the cave, are under study by different scholars. It is worth mentioning that a few fragmentary human remains were uncovered during the Kökten excavations, but their provenience is uncertain. One milk tooth (Ldm2) found by Kökten in 1949 was identified as belonging to a Neanderthal child (Senyürek 1949). In 1986 two additional teeth were uncovered in archaeological units 5 and 7 respectively in square I15(=A2). One is a premolar (Lm1) of a 5-year-old child, and the second is a milk tooth (Yalçinkaya 1988a:23). In 1987 one tooth and a humerus head were found in archaeological unit 3, square G 17 (=A4d). It goes without saying that additional human remains are needed in order to achieve a better definition of the Mousterian population of Anatolia.

The following report on the Mousterian assemblages is only preliminary and is based on observations made on the layers excavated before 1990. Detailed techno-typological analyses are underway.

The Mousterian industry of Karain is mostly of local raw material, collected in the small valleys that descend from the main ridge to the flat alluvial cover of the plain. The cobbles and pebbles are mainly radiolarite and flint or chalcedony. Hydrothermal black and transparent flint and limnoquarzite, possibly originating in a volcanic region to the north, and brown flint with granuled cortex was brought from the northwest.

The industry is characterized by the use of Levallois technique. It seems that often in the primary phase of removals the cores were bipolar and recurrent (Boëda 1988) and became progressively Levallois radial or fully discoid. This process led to the increased importance of disks in the industry of Karain (Figs. 3.4, 3.5). Thus, these objects could be either extremely exhausted Levallois cores or, alternatively, small radially shaped pieces.

Racloirs form the main tool group among the retouched pieces; double-sided racloirs, often with abrupt retouch on one edge and a flatter retouch on the opposite side, dominate. Canted (*déjeté*), convergent, and transverse racloirs are less frequent (Figs. 3.4-3.12). Points are present in most archaeological units but are more numerous in the lower part of the studied sequence (Fig. 3.11). The overall impression of the shaped blanks and the common scaled retouch, which reflects phases of resharpening, is that it resembles the "Charentian." Finally, we remark the presence of a few foliates and a rare, backed biface that was found in archaeological unit 9 (Fig. 3.6).

In general the number of retouched pieces is relatively high when compared to the number of available blanks of the same dimensions. It seems, therefore, that part of the production process took place in other locales, perhaps near the sources of the raw material.

Given the particular geographic position of Karain, it is interesting to compare this Mousterian industry to the two neighboring regions, namely, the Balkans and the Levant.

The basic classification of Middle Paleolithic industries of the Balkans, as proposed by Kozlowski (1975), was essentially based on the dichotomy between assemblages rich in racloirs (the "southeastern Charentian") and those characterized by the abundance of Levallois technique. These Levallois-dominated assemblages are often associated with foliate points and are subdivided into three groups: Mousterian-Levalloisian, the Mouselievo-Samouilitsa Mousterian, as well as the Typical Mousterian rich in racloirs. This proposition was amended by Ivanova (1979), who subdivided the first group of the Balkanic Mousterian on the basis of the racloir index into two facies (a) the Kamen-Londja, which is the richest in racloirs, and (b) the Pinios Crvena Stijena group, in which racloirs are relatively less frequent but the number of Mousterian points is higher. However, the combination of "Charentian" characters with intensive use of the Levallois technique, which prevails in Karain, is unknown in the Balkans with only one exception. The morphology and structure of the Karain racloirs resemble the group of racloirs from layers XXIV-XXII in Crvena Stijena (Red Cave) near Niksic in Montenegro (Yugoslavia). Comparison with layer XXV of this site indicates the presence of a similar ventral invasive and thinning retouch (cf. Basler 1975: Pl. 25:6, 7, 11; Pl. 26:1; and see Fig. 3.6). The trend among the racloir group in layers XXIV and XXIII in Red Cave, where they were made on thick "Pontinian" flakes and shaped by scalar retouch, is found also in archaeological units 10 and 11 at Karain.

It is quite possible that similar industries to those of Red Cave were present in the eastern Balkans, mainly in Thessaly and the Peloponnese. Unfortunately, most of the available material collected there was from the surface of alluvial deposits, and its homogeneity is in doubt (Freund

1971; Reisch 1982).

The presence of bifacial elements in the Karain sequence, namely in archaeological units 9 and 17 (Fig. 3.6, 3.9) represent two categories: (a) the asymmetric racloirs-knives with distal thinning and natural back, and (b) the transitional type between the *Blattspitzen* and the *Blattschaber*. The first type has no analogies in the Balkan but does in the Levant, with certain Acheulo-Yabrudian pieces from Tabun Cave. The second type has nothing in common, in either typology or technology, with the Balkanian foliate points known from the Mousterian-Levalloisian (such as the Mouselievo-Samouilitsa and the Kokkinopilos). Instead, it resembles the rare bifacial foliates from the "Balkanian Mousterian," such as those from Kamen in Bosnia (Kozlowski 1975: Fig. 15). This kind of Mousterian from Red Cave in Montenegro does not differ from the above-mentioned assemblages from Montenegro.

It is worth mentioning that according to Brunnacker (1975) the deposits of layer XXIV from Red Cave are of the Last Interglacial Age (probably Isotope Stage 5e), which may be taken as an indication of the age of the similar industry in Karain.

The "Charentian" aspect of the Karain industry with the intensive exploitation of the Levallois technique is found only in the Zagros cave-sites such as Bisitun and Warwasi (Dibble 1984; Dibble and Holdaway 1990; also this volume).

The Levantine Mousterian differs greatly from the Mousterian of Karain. Currently, the Levantine sequence is based on the long stratigraphy exposed in Tabun Cave in Mt. Carmel, where three major units were defined on the basis of both earlier excavations by Garrod (Garrod and Bate 1937; Copeland 1975; Bar-Yosef 1989), and the more recent ones by Jelinek (1982). The later Mousterian is named "Tabun B type" and is also found in Kebara and Amud caves (Meignen and Bar-Yosef 1988). It is characterized by the broad-based short Levallois points and general convergent Levallois recurrent reduction sequence (Bar-Yosef and Meignen 1992).

The "Tabun C type" industry, associated with the hominids in Qafzeh and Skhul, is dominated by the radial and bipolar Levallois technique. Points are in much lower frequencies in these assemblages (Boutié 1989).

The earliest Mousterian industry—the "Tabun D type"—is characterized by unipolar and bipolar Levallois technique, and high frequencies of blades and points. Assemblages of this type were recovered in the Negev in Rosh Ein Mor and Ain Aqev (Crew 1975; Munday 1979) and in the Palmyra basin in Douara layer IV and Jerf Ajla (Akazawa 1987; Schroeder 1969). Farther north, in the El-Kowm basin, a somewhat similar industry, named Hummalian, is dominated by blades and elongated points and occupies the same stratigraphic position as Tabun D, namely above the Acheulo-Yabrudian (Hours 1982).

In an overall review one may suggest that the proliferation of the Levallois technique in the Levant, which is often accompanied by rather low frequencies of retouch pieces, is due to the great abundance and accessibility of good-quality, large nodules of raw flint. In the Taurus-Zagros ranges the situation is different. The raw materials, even when abundant, are smaller in size, and the evidence for resharpening is clearly evident.

In sum, the current excavations at Karain Cave demonstrate that the Mousterian sequence is deeper than 3 m and is incorporated in several sedimentary cycles that may therefore represent a long period. The high frequencies of racloirs provide a Charentian character, which, together with the intensive exploitation of the Levallois technique, reflect the uniqueness of this industry when compared to the Balkans and the Levant. Its similarity to the Zagros Mousterian seems evident, although further analysis may disclose the particular patterns of this Anatolian site. The major hiatus between the Mousterian deposits and the Epipaleolithic accumulations indicates that most of the Upper Paleolithic sequence is not present in this site. Further investigations in the region are needed before firmer conclusions concerning the presence or absence of the Upper Paleolithic entities can be drawn.

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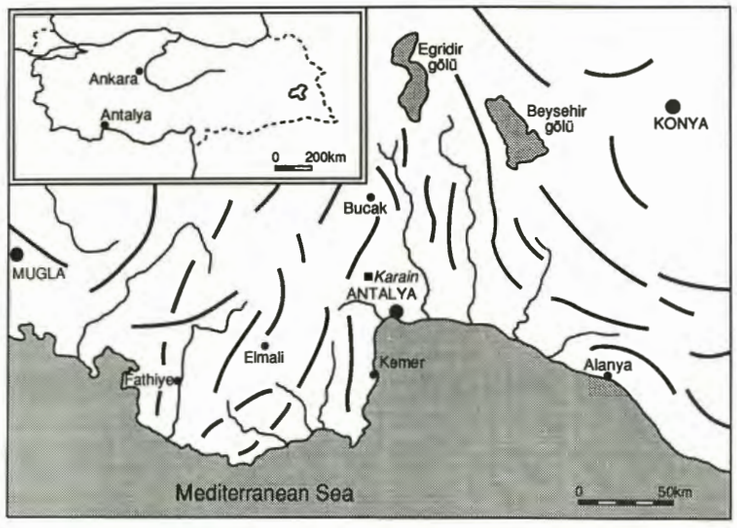


Figure 3.1. Map of Turkey indicating the location of Karain Cave.

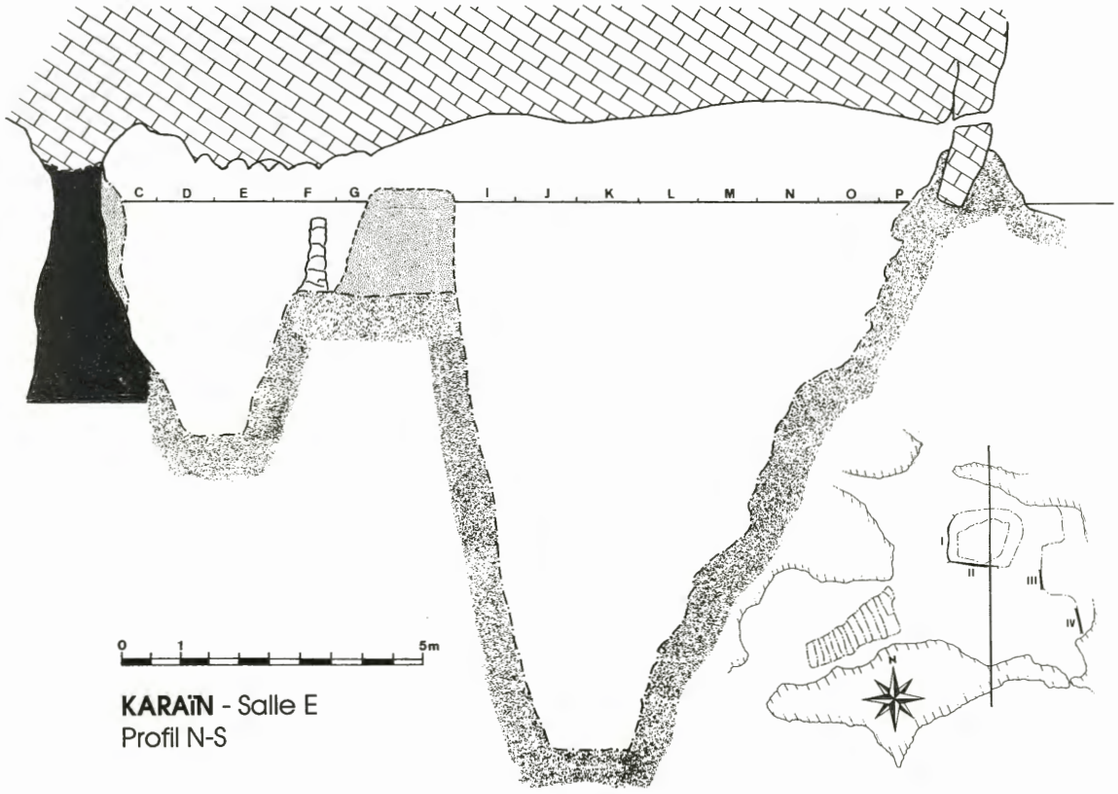
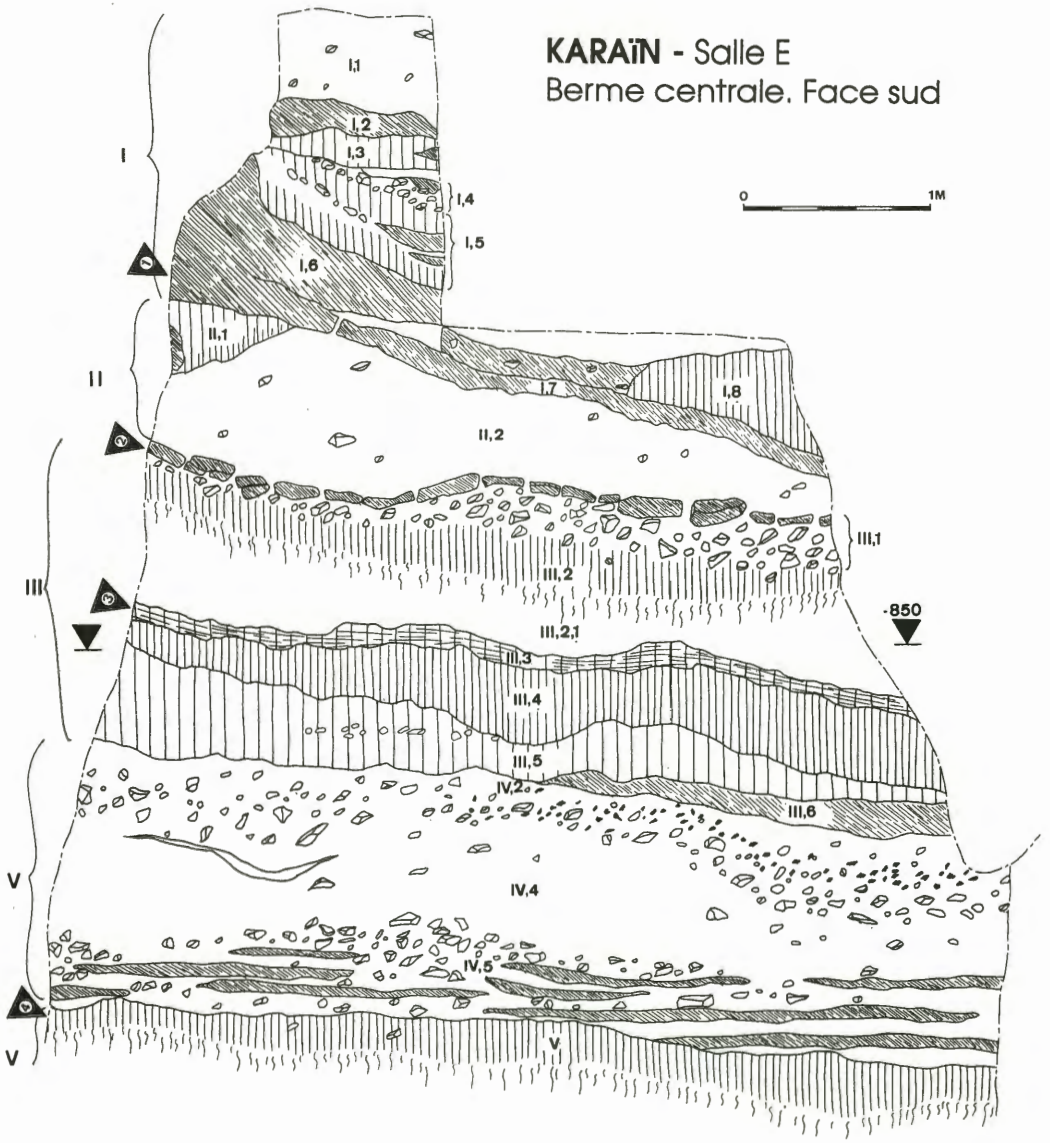


Figure 3.2. Generalized north-south cross section through chamber E at Karain Cave. The section of Figure 3.2 corresponds to the stippled area of the "berme centrale." A reduced map of the cave indicates the location of this section. The entrance to the cave is on the lower left corner.



Rocky deposits

- bedrock

- calcite or old brecciated deposits eroded by the renewal karstic activities

Colluvial Deposits

-mixed colluvium that contains altered elements

-humic rich colluvium

-stratified colluvium

Alteration

-palaeosol or colluvium altering the lower layer

Sediments originating in the exterior

-(eolian?)

-Calcite or hardened sediment

Figure 3.3. *Cross section through the main columnar "berme centrale" indicating the layers with indurated calcitic deposits. The numbers of the units (Roman numerals) and layers (Arabic numerals) correspond to the drawing of the Middle Paleolithic artifacts in Figures 3.4-3.12. Please note that due to lateral changes within the "berme centrale" layer I,8 effectively overlies layer I,7.*

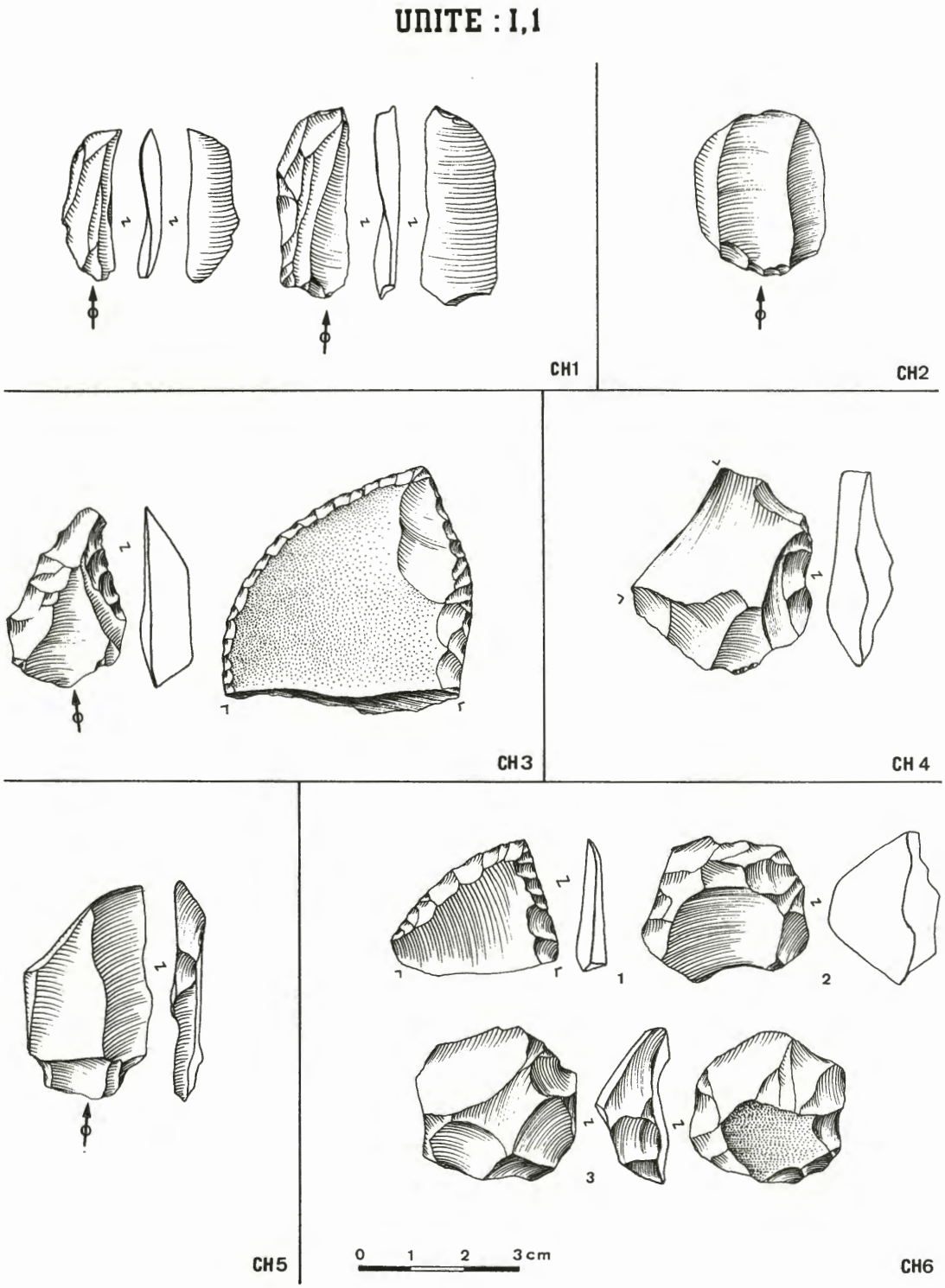


Figure 3.4. *CH 1: two microblades (late Paleolithic); CH 2: unidirectional flake; CH 3: coarsely retouched pointed flake and convergent scraper; CH 4: broken Levallois core; CH 5: "énlevement II," side ridge flake; CH 6: convergent scraper, a small radial Levallois core, and a bifacially flaked disk.*

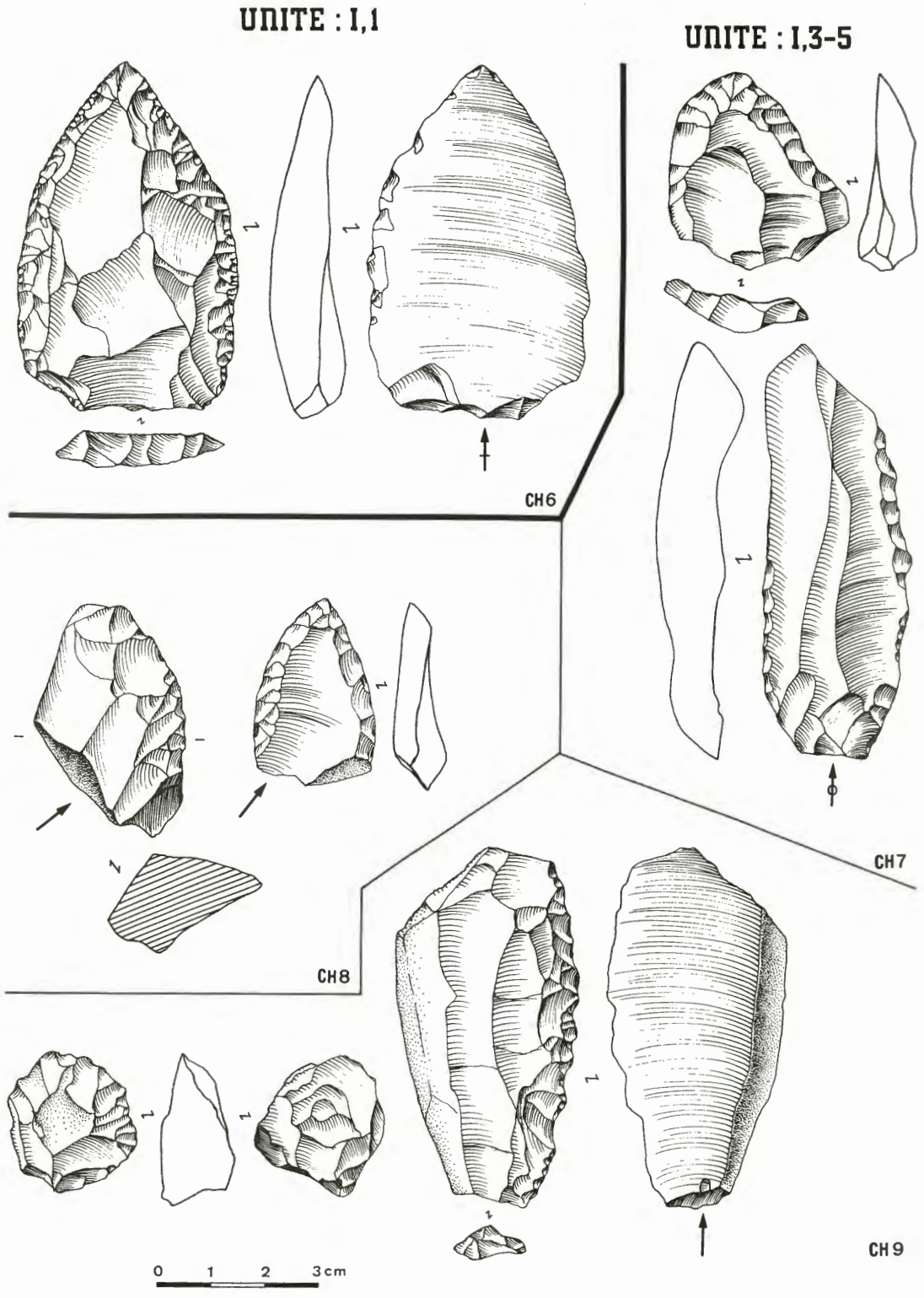


Figure 3.5. *CH 6: convergent scraper; CH 7: a scraper on Levallois flake and a unidirectional thick blade partially retouched; CH 8: steep Quina scraper and a small canted point; CH 9: a disk and a side-scraper.*

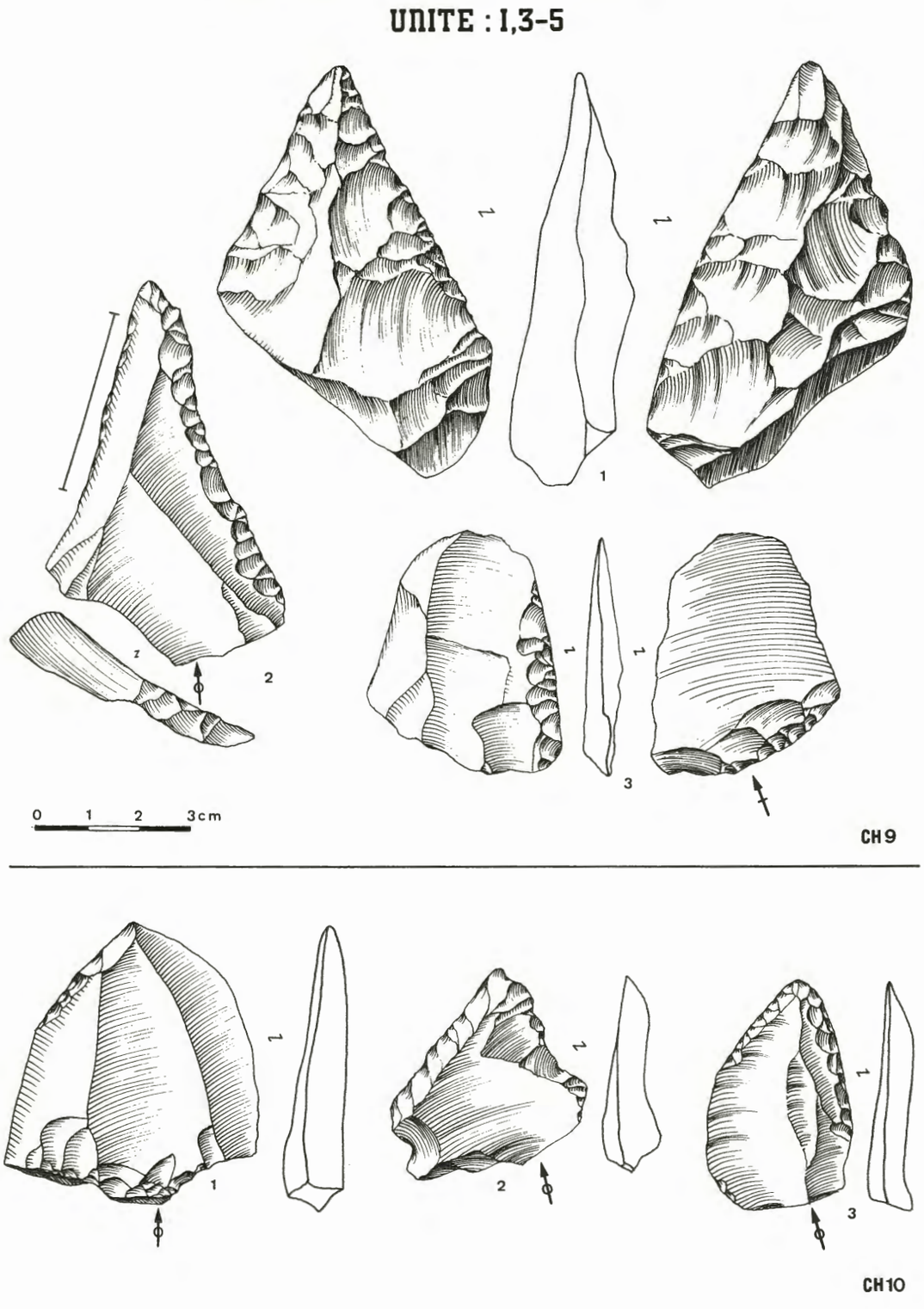


Figure 3.6. *CH 9: (1) a broken biface, (2) a side-scraper on convergent Levallois triangular flake; (3) Levallois side-scraper with retouch removing the bulb; CH 10: (1) convergent prepared flake, (2) canted side-scraper, (3) convergent scraper.*

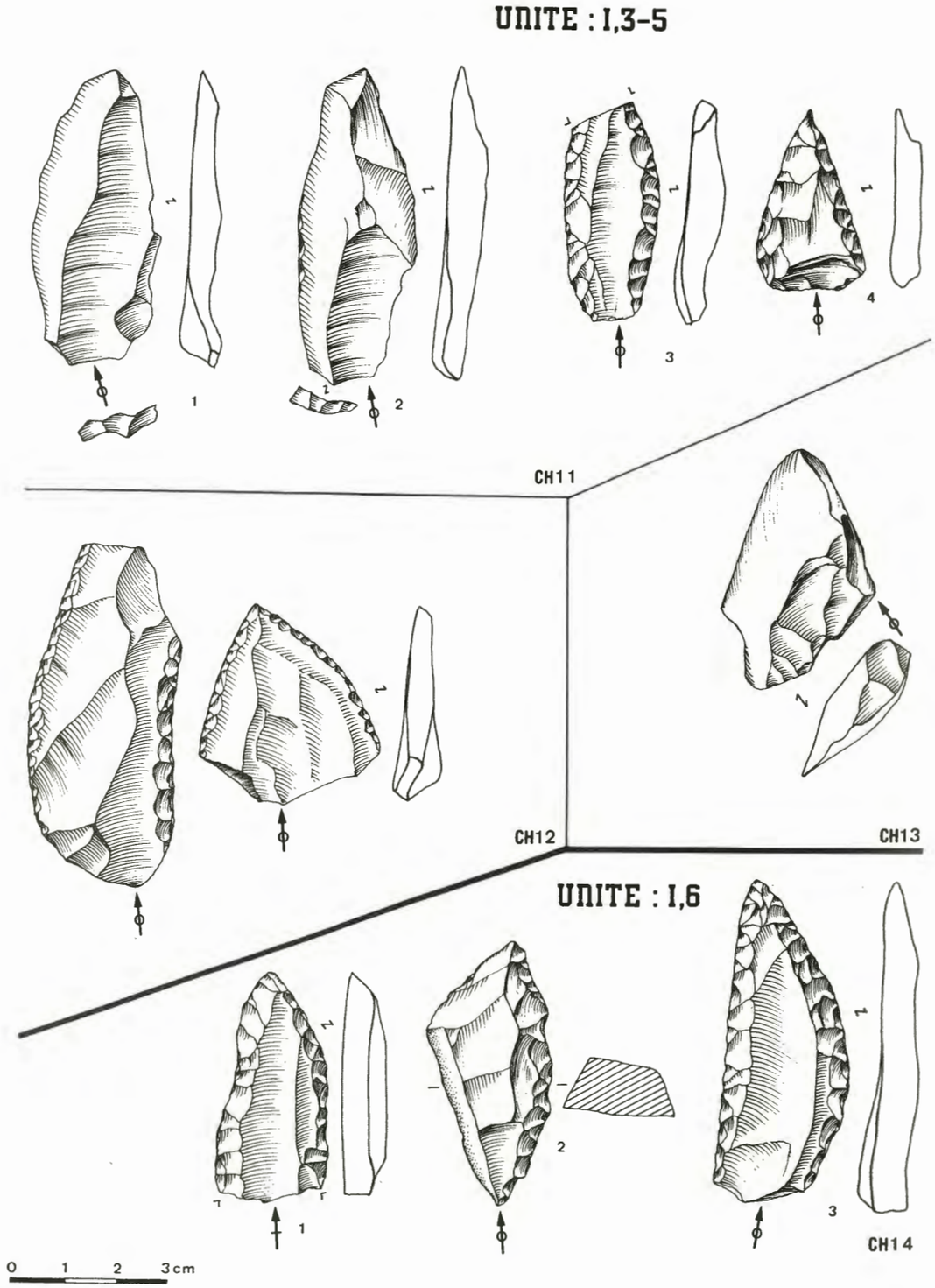
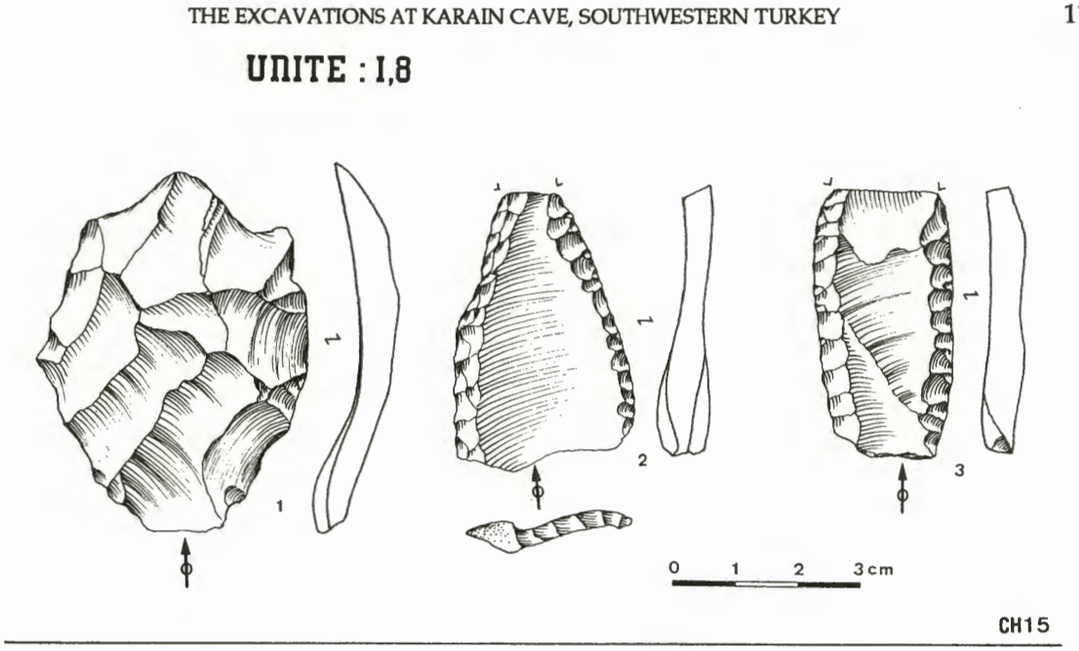


Figure 3.7. *CH 11: (1) Levallois unidirectional blade, (2) Levallois ridge blade, (3) broken double side-scraper, (4) retouched point; CH 12: double side-scraper and a convergent scraper; CH 13: inversely flaked flake; CH 14: (1) convergent scraper, (2) semi-Quina side-scraper, (3) convergent scraper.*



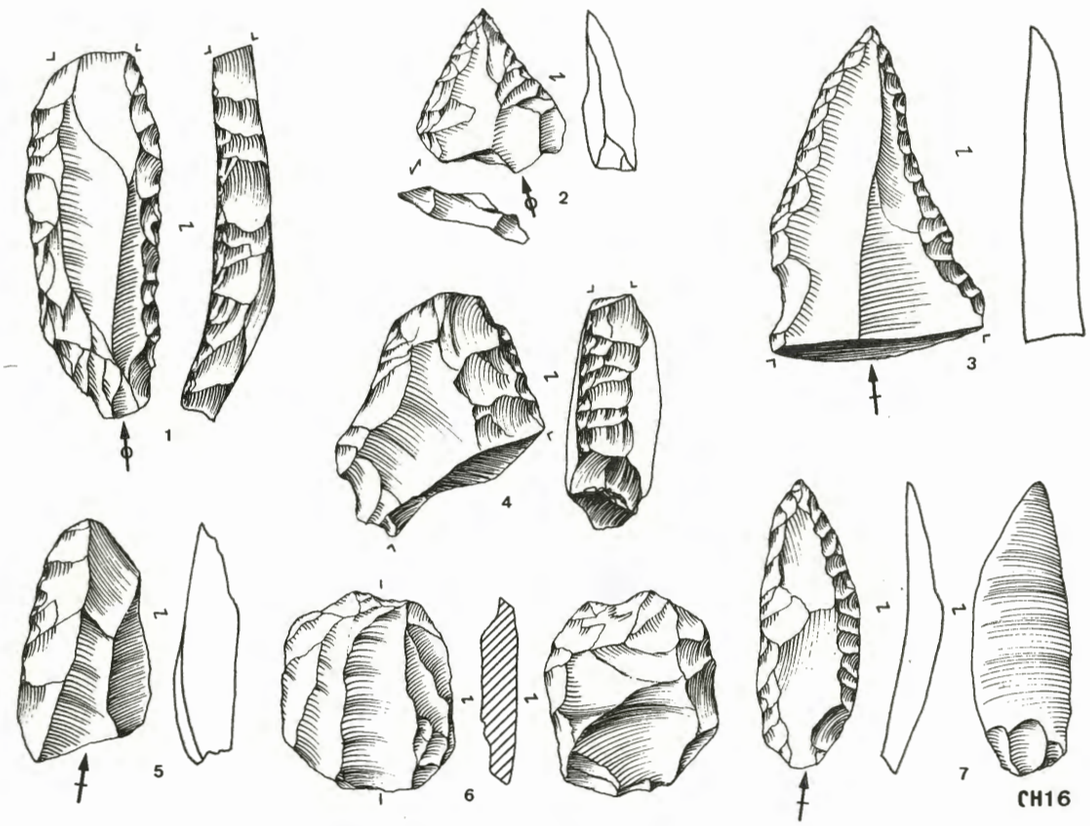


Figure 3.8. *CH 15: (1) radial Levallois flake, removal of the entire surface of the core, (2) broken retouched point, (3) broken double side-scraper; CH 16: (1) broken double side-scraper, (2) retouched point, déjeté, (3) broken retouched point, (4) broken double Quina scraper, (5) flake, (6) small discoidal core or a disk, (7) leaf-shaped point.*

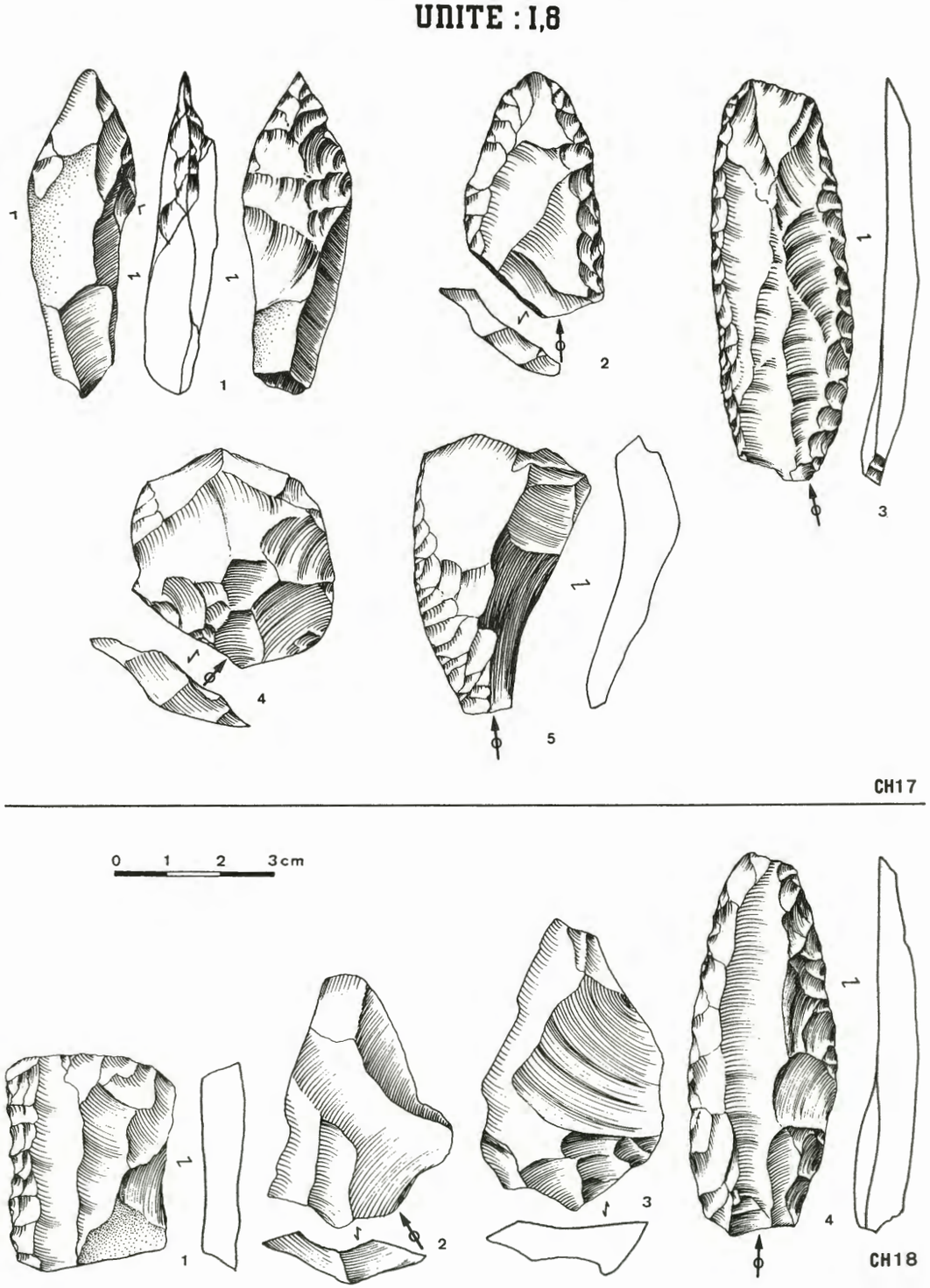


Figure 3.9. *CH 17: (1) broken bifacially pointed piece, (2,3) double side-scrapers, (4) radial Levallois flake, (5) side-scraper; CH 18: (1) side-scraper, (2) pseudo Levallois point, (3) flake, (4) double side-scraper.*

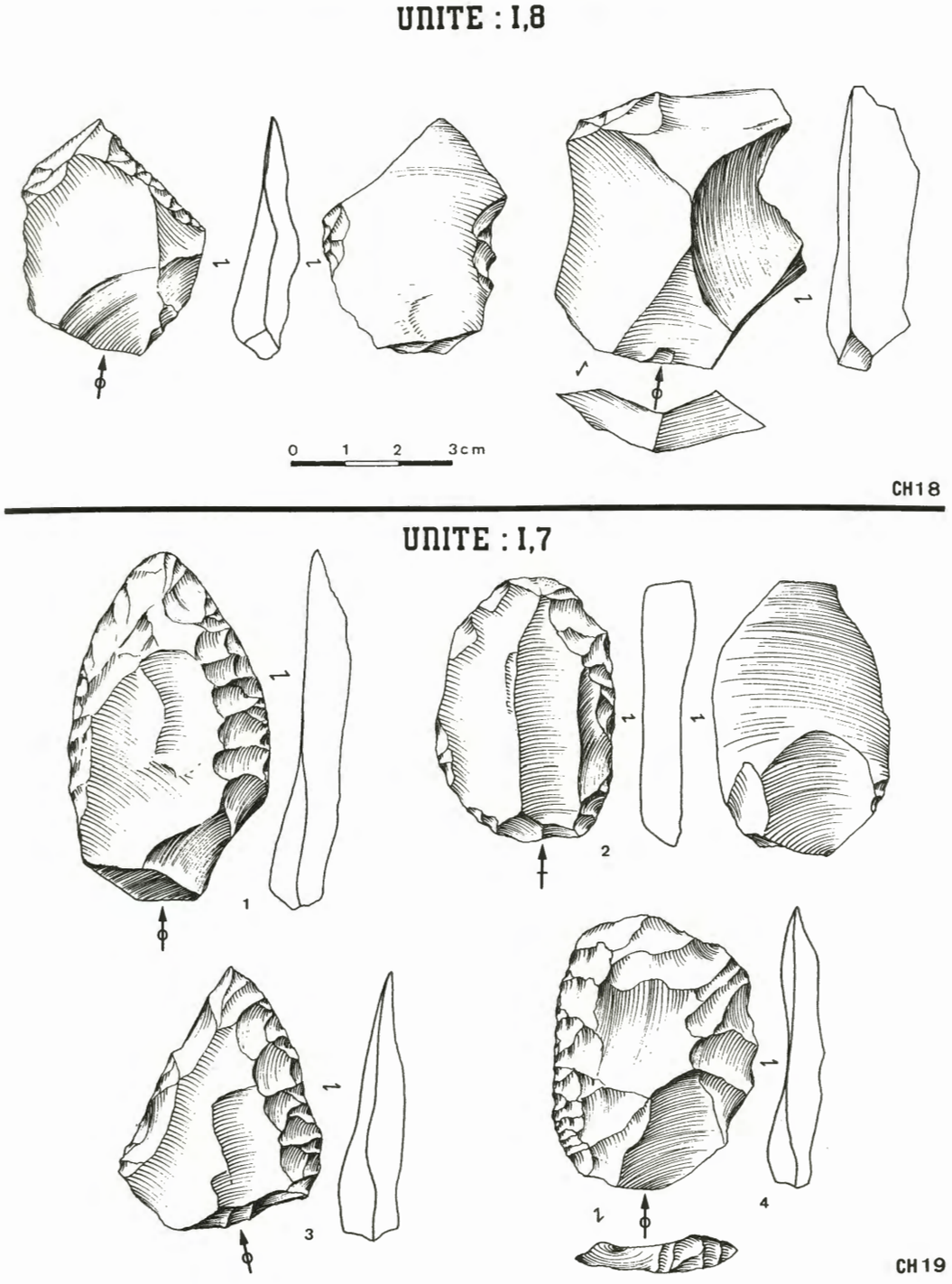


Figure 3.10. *CH 18: déjeté side-scraper and a radially prepared thick flake; CH 19: (1) convergent scraper, (2) side-scraper, (3) asymmetrical retouched point, (4) side-scraper on radial Levallois flake.*

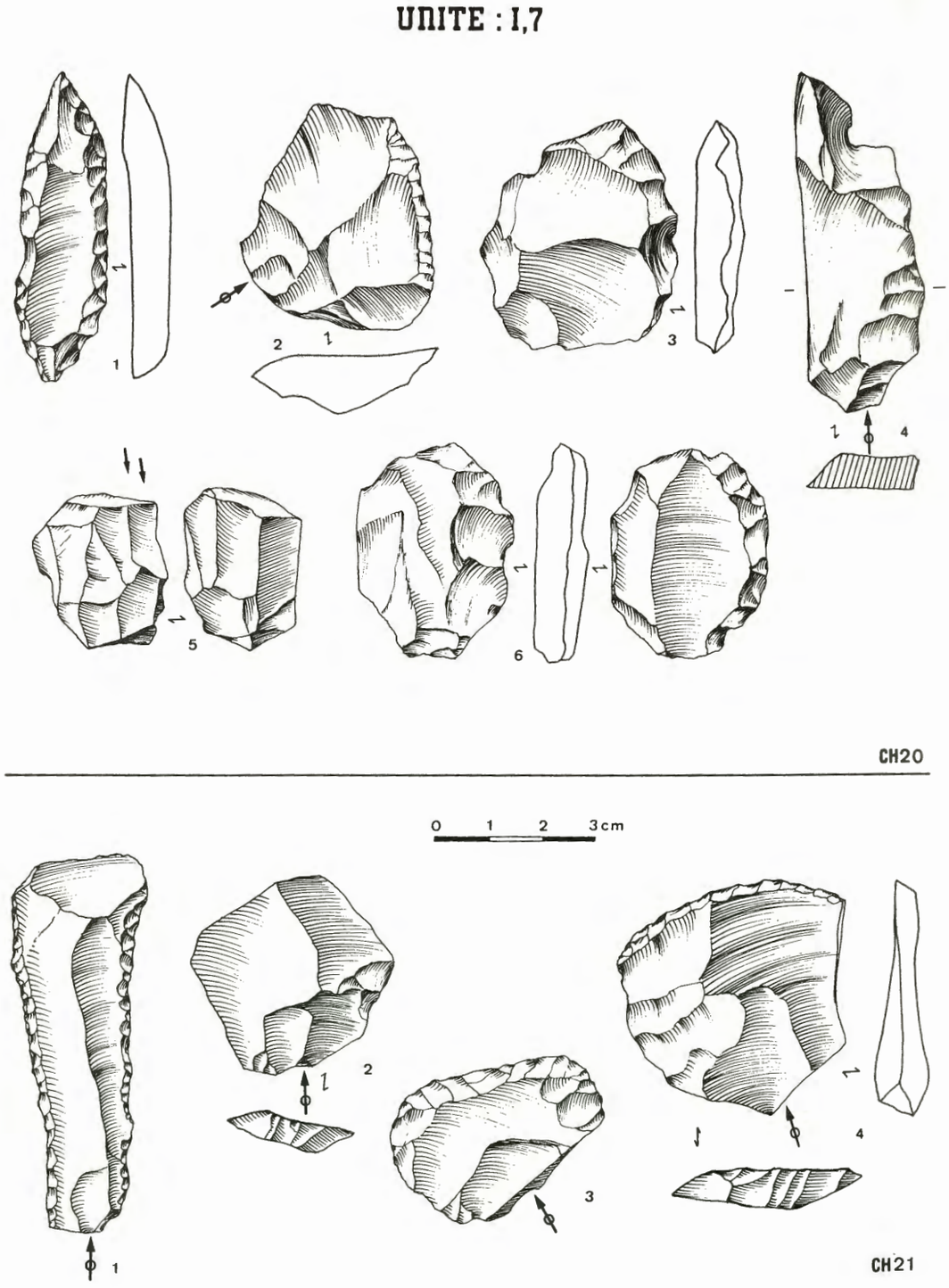


Figure 3.11. *CH 20: (1) double pointed convergent scraper (limace?), (2) déjeté side-scraper, (3) radially prepared Levallois flake removed from the entire core surface, (4) Clactonian notch, (5) burin on a break, (6) a small Levallois core; CH 21: (1) double side retouched blade, (2) flake with faceted platform, (3) déjeté scraper, (4) transverse scraper on Levallois flake.*

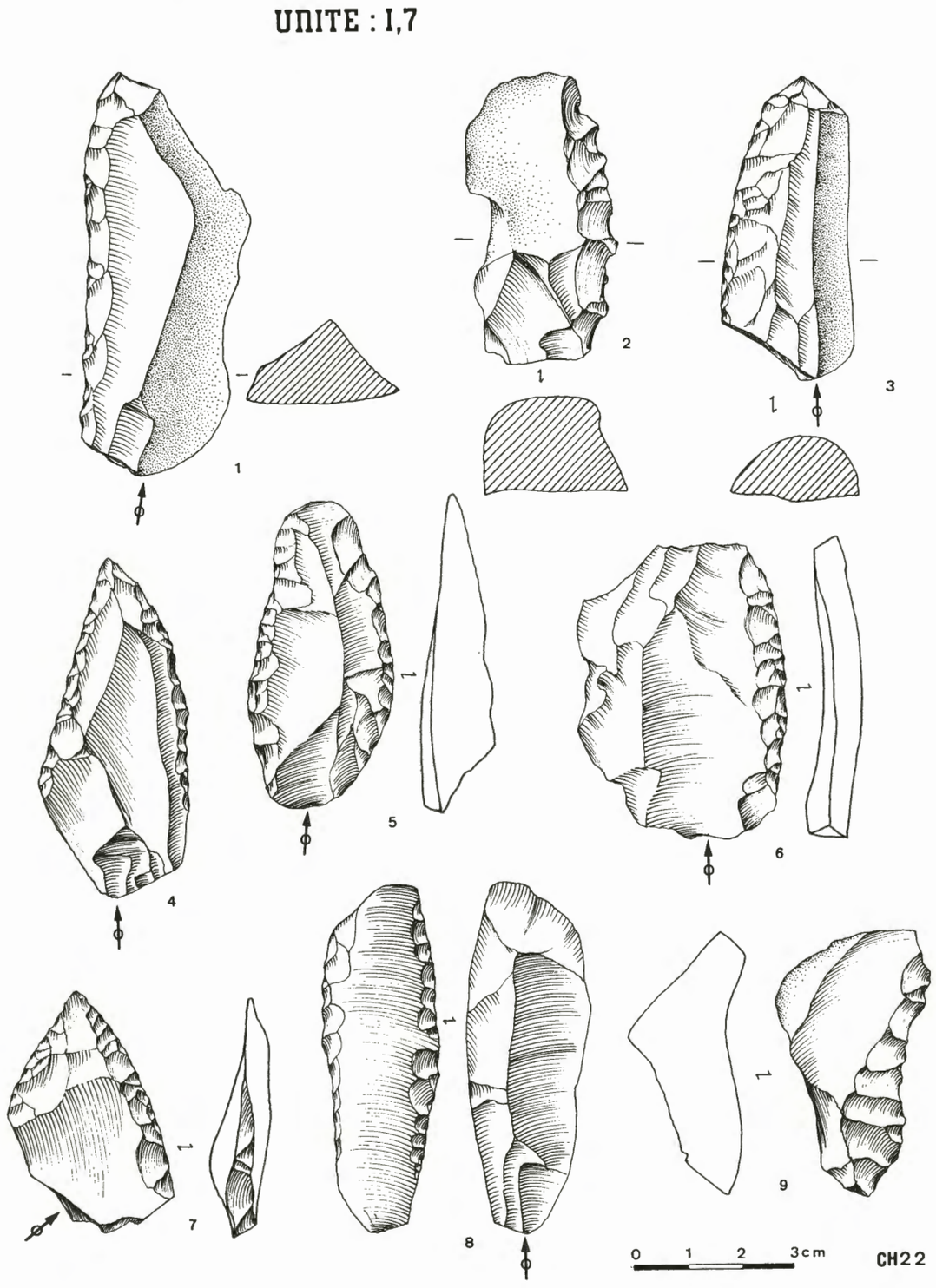


Figure 3.12. *CH 22: (1) side-scraper, (2) denticulate, (3) semi-Quina side-scraper, (4) convergent scraper, (5) double side-scraper, (6) side-scraper on Levallois flake, (7) déjeté scraper, (8) inversely retouched double side-scraper, (9) denticulate concave scraper.*

4

The Pointed Tools from the Mousterian Occupations of Shanidar Cave, Northern Iraq

Ralph S. Solecki and Rose L. Solecki

We are addressing the Mousterian occupations (Layer D) of Shanidar Cave, in northern Iraq, and specifically a particular class of artifacts characteristic of the Shanidar Mousterian industry. These tools have at least one pointed end, and according to the Bordian Middle Paleolithic typology (Bordes 1961), would for the most part be classified as Mousterian points, limaces, converging side-scrapers, *déjeté* side-scrapers, and perforators (Table 4.1).

Beginning with a general chronological review of the Layer D lithic industry and other cultural data, we then examine the correlation of these data with stratigraphic subdivisions in the Layer D Mousterian occupation. In the concluding sections of this paper, we discuss the pointed tools and review the validity of the Mousterian pointed tool types and their possible functions.

THE MOUSTERIAN OCCUPATION IN LAYER D

The present analyses of the flint implements are far more sophisticated than those previously done for Mousterian collections. Earlier work was hampered by the separation of the Shanidar collections, which are located in both the United States and Iraq. The greater part of the collection is in Baghdad. With the present better understanding of Mousterian technology and typology, we were prompted to take a new look at the stratigraphy of Layer D, with the relationship of the tools to the occupation of Shanidar Cave as our objective.

As in all researches in prehistory, our data reflect sampling and recovery. In a total surface floor area at Shanidar Cave, measuring about 1086 m^2, we exposed a surface area of about 136 m^2 in the excavation, which was begun in the only clear area of the cave floor, the front and central part. There were small-sized uninhabited brush houses and corrals clustered around the interior walls and toward the rear of the cave area. It developed that several families (about forty-five Kurds and their animals) moved in annually during the late fall and winter months to spend the cold season in the cave. One might say that in ancient times the prehistoric peoples probably followed the same pattern as the modern Kurdish peasants, namely, favoring habitation along the interior walls of the cave and leaving the center and front clear (R. S. Solecki 1979).

Assuming that the preferred living area of Shanidar Cave was around the inner walls and toward the front, our excavation was possibly not made in the area of the densest prehistoric occupation. Of course, the perimeter of the floor at the cave walls could have been choked up with fallen boulders and rendered uninhabitable.

In order to facilitate laboratory study of the cave contents, the cave excavation was divided into forty-four arbitrary foot levels (Solecki, McGovern,

and Campana 1975). Following the scale used the first and second seasons, each level was a foot, or ca. 30.5 cm. The information recovered from these levels was plotted on large-sized Plexiglas sheets. These data included cultural and non-cultural material. Layer D falls between Levels 14 and 44.

During the four seasons we spent at Shanidar Cave, the excavation was stepped back in depth in order to minimize the chances of accidental caving in of the walls. Of the four major cultural horizons (A, B, C, and D) identified in this way, more of Layer A (Neolithic to Recent) was exposed than Layer B (Proto-Neolithic and Epipaleolithic), more of B than C (Upper Paleolithic or Baradostian), and naturally more of C than D (Mousterian). In the latter horizon, the excavation had a surface area of ca. 112 m^2 at Level 14 (3.9–4.2 m) at about the boundary of C and D. At about the level of Shanidar Neanderthal No. 1 in Level 15 (4.2–4.5 m), the excavation measured 100 m^2 in area. At Level 19, the excavation measured about 60 m^2 in area. At about Level 28, the excavation was a shaft stepped back farther in stages to bedrock at Level 44 (ca. 13.4 m). From Level 14 to Level 44, the volume excavated was about 380 m^3.

A massive stone block fallen from the ceiling hindered excavation to the north, and massive rockfalls and stone blocks sealed in the deposits to the south. The latter may have been a combination of rockfalls from the ceiling and from the area of the front cave overhang. From the evidence in our excavation, there appears to have been at least nine major rockfalls during the Middle Paleolithic age, covering a span of an estimated 40,000 years (from ca. 40,000 to ca. 80,000 years ago). We have two dates approximately fixing the upper limits of Layer D, but can presently only guess at the lower limits.

The major rockfalls carried with them a number of uncounted smaller rockfalls coupled with the larger and more massive collections of roof debris. It was evident from the first that these rockfalls understandably had a marked effect on the available living space in the cave. The rockfalls were due to structural weaknesses of the limestone, undoubtedly hastened by freezing and thawing action annually, and by the ever present danger of earthquakes (Degg 1990). The cave lies near a fault line. It appears that the stone age occupants modified some of the floor area for their living convenience, moving stone blocks and on occasion leveling the floor with earth. One cleared floor area measured 4 x 6 m, and included six hearths. Two portable-sized limestone rocks close to one of the hearths exhibited shiny polish as though from attritional wear on their surfaces. A total of 129 hearths were counted in the Mousterian layer (R. S. Solecki n.d.). More than one fire hearth had been down-warped out of shape by rockfalls. The rockfalls also made very effective man traps, as we have observed elsewhere (R. S. Solecki 1971).

In material culture, the Mousterian horizon yielded fewer artifacts (798) than the overlying culture horizons. We estimate that about two artifacts per cubic meter were excavated in Layer D. It must be remembered, of course, that much of the volume was taken up with the large blocks of stones. The top of Layer D dips at first markedly to the north with a slant of about 5 ft. (2.52 m) in a distance of 20 ft. (6.10 m). This appears to have been brought about by the massive rockfall that closed the top of the Middle Paleolithic layer. Below this rockfall zone, the sediments assumed more of a horizontal aspect, attaining a slope of more or less 1 ft. (30.48 cm) in 20 ft. (6.10 m). This slight slope incline was marked in the heavy dark zone of occupation in about the middle of Layer D (see Fig. 4.9).

Because the relatively heavy and numerous rockfalls noted above evidently had a direct bearing on the human occupations of Shanidar Cave, a provisional summary of these phenomena is given here. So far as we can tell from our excavation, the first rockfall occurred at about Levels 35–36 (ca. 11 m). We believe that the boulders tumbled in from the cave mouth. There was a second marked rockfall at about Level 31 (ca. 9.45 m), in which large boulders were found. A third rockfall of heavy intensity, really a succession of rockfalls, occurred at about Level 28 (8.54 m). Another heavy rockfall, number 4, was found at about Level 26 (7.93 m). A fifth rockfall was evidenced at about Level 25 (7.62 m), which contributed to the death of Shanidar Neanderthal II. A sixth rockfall was encountered at about Level 22 (6.71 m). It was followed shortly after by a seventh rockfall at about Level 20 (6.10 m). At about Level 17 (5.18 m), there were so many boulders in the excavation that much time was spent in their removal. One of this rockfall series had killed Shanidar III, at about 5.4 m. There appeared to be a final succession of rockfalls at about Levels 14–15 (4.27–4.57 m) that literally choked up the excavation, and finally closed off the Mousterian occupation. One of this last series (no. 9

rockfall) killed Shanidar I and V at about 4.3 m to about 4.4 m. This rockfall appears to have been the result of a massive ceiling collapse. The probable timing of this rockfall was somewhere between 50,000 to 45,000 years ago, from the carbon 14 dating (R. S. Solecki 1963).

Elsewhere (R. S. Solecki n.d.), we have divided Layer D provisionally into four major stratigraphic horizons. For the purposes of this paper, it appeared to be more useful to make a finer discrimination; accordingly, we provisionally recognize seven divisions in Layer D, called here D1, D2, D3, D4, D5, D6, and D7. Layer D4 is further subdivided into three horizons, D4a, b, and c (see Fig. 4.10).

The topmost stratigraphic horizon recognized in our excavation, D1, extends from the close of the Mousterian horizon and the beginning of the Upper Paleolithic (Baradostian) Layer C. In depth, it is from about 4 m to about 5.15–5.5 m. It is composed of a sticky, dark brown, sandy loam containing many limestone fragments and particles, many large boulders, some charcoal flecks, and occasional fire hearths. As noted above, the excavation trench was choked with the many large boulders. No clear occupational levels were discerned. Two carbon 14 dates, 46,000 b.p. and 50,000 b.p., were obtained in this horizon (R. S. Solecki 1963). According to Arlette Leroi-Gourhan, from the small amount of pollen that she was able to extract from the sediments, the deposit showed a trend to a wet climate (R. S. Solecki and Leroi-Gourhan 1961).

The next horizon, D2, extends from about 5.18 m to 5.49 m, or Levels 17–18. It is a light brown sandy loam marked by an absence of large boulders and few limestone particles and fragments. It contained occupational traces, including charcoal bits.

The next horizon, D3, extends from about the middle of Level 18 to about Level 23, or between about 5.49/5.79 m and about 7 m in depth. It is also a light brown sandy loam, containing charcoal flecks, hearth traces, and evidence of rockfalls.

With the next horizon, D4, we see a marked change in the composition of the sediments, making discrimination very easy. This is undoubtedly due to the organic element, which makes the sediment much darker than the overlying sediments in Layer D. It is a thick zone, extending from about Level 23 (7.01 m) to about Level 33 (10.06 m). It may be divided into at least ten finer subdivisions. For the purposes of this discussion, we lump the sediments into three major horizons, D4a, b, and c. Interfingering these Layer D4 sediments are two lime-impregnated sediment horizons, which may be called "marker" beds. These horizons are really occupational zones that had evidently been soaked with lime or CaCo3-rich water and hardened to a crustlike texture. They include one lime-hardened zone about 12.5 to 15.5 cm thick extending across the excavation floor between Levels 28–29. A somewhat smaller patch of lime-hardened occupational sediment was found at Levels 32–33 (ca. 9.76–10.06 m). This is quite close to the bottom of the heavy organic stained horizon of Layer D4.

The subdivision of Layer D4 into three major subdivisions is a tentative one. Layer 4a extends from about Level 23 to about Levels 25–26, or between about 7 m to 8.1 m. It consists of a dark mixed loam containing bands and lenses of charcoal and ashes (see Fig. 4.9). Layer 4b extends from Levels 25–26 to about Levels 28–29, or between about 8.1 m and 8.7 m. It is a dark brown loam containing limestone fragments and marked by many occupational traces such as hearths and charcoal traces. There is a partial blanket of rockfall at its base. Layer 4c extends in depth between about Levels 28–29 and about Level 33, or between about 8.7 m and 10 m. It is mainly a dark grayish brown loam containing streaks of charcoal, hearths, and heavy organic stains.

Layer D5 is an anomalous sediment horizon that was almost culturally sterile. It extended from the lime-hardened sediment about Level 33 to about Level 35, or between about 10 m and 10.6 m. It is about a 60–70 cm thickness of grayish brown sandy loam, a sediment with claylike hardness. As noted above, few flints (intrusive?) or other cultural material was found in this horizon. There is a marked break in the sediment color from the dark organic stained zone of D4 to the much paler sediment color of D5.

At about Level 35 (ca. 10.6 m), the sediment texture changes to a grayish brown sandy loam, marking Layer D6. It has a thickness of about 80 cm, extending down to Level 37, or about 11.3 m. There was a rockfall at the base of this horizon, and between Levels 37 and 38 (ca. 11.5 m) was about an 8 cm thickness of lime-hardened sediment much like the lime-hardened sediments encountered above. The close association of rockfalls with lime-hardened sediments appears to have some significance.

Layer D7, which extends from the base of D6 to bedrock, is composed of a grayish brown sandy stony loam. In this horizon were found some cultural materials including hearths and artifacts. It was quite obvious that Mousterians had discovered the cave early in its history of filling. Bedrock, which was cracked and fissured, slanted to the north and west. There was no mistaking that it was bedrock, rather than another large boulder. A hearth was placed just about on the bedrock base.

The sections have yet to be examined in detail and studied by a Pleistocene geologist. We had planned to have a highly qualified geologist on our team during the third season, but his participation was aborted at the last moment. However, we were able to collect a complete sample of sediments from top to bottom of the excavation for future analysis. Some of the samples have already been studied for pollen, others have been examined by a soils specialist at the U.S. Department of Agriculture, and other samples are in the process of examination or restudy.

We have some hints about climate change at Shanidar from the evidence in the sediments. Arlette Leroi-Gourhan's study of the pollen samples from Layer D1 at about 4.25 m indicates that there was a trend to wet climate. This was the period in which there was a succession of small as well as large or massive rockfalls. Bruno Sabels' analyses of trace elements suggest that the sediment from the 7.3 m horizon in the upper part of our D4a layer shows a cold and moist environment (R. S. Solecki 1963). Leroi-Gourhan's pollen analysis from sediments close to the same depth (7.5 m) indicates to her that there was a cooling of the climate. Thus, we can say with some confidence that the climate experienced during the laying down of the D4a sediment was a cooling/cold moist period. The sediment samples were taken from quite close to the zone of rockfall number 5 in our series. Sabels also suggests that there was a cool climate at a depth of about 8.3 m. Leroi-Gourhan's results from her pollen studies from about the same depth (8.6 m) shows that the climate was wet. We should point out here that these depths coincide with the lime-hardened sediment zone in Levels 28–29. Rockfall number 3 in Level 28 occurred about this time (see Fig. 4.10).

We do not know if the limed sediment between Levels 32 and 33 and that between Levels 37 and 38 had any climatic relationships or not. However, it is likely that they may, like the lime-hardened sediment in Levels 28–29, have resulted from exposure to a cool, moist environment. These patches of limed sediment lay in the neighborhood of rockfalls numbers 2 and 1 respectively. Whether we can make a case for a relationship of these limed features and the onset of the rockfalls we cannot say. However, their close association with rockfalls is suggestive. We must hasten to add that estimating the initial impact depth of a rockfall on a slanting cave floor defies precision measurement.

Turning to the cultural data that is the focus of this chapter, we found that the distribution of the Mousterian pointed tools in Layer D (Table 4.1) indicated that there was an extraordinarily heavy concentration of these tools in Layer D4. In order to better understand this situation, we turned to other cultural data from the Mousterian layer. These included other tools (and use-retouched flakes), debitage, animal bones, and hearths. With the exception of the hearths, where there was an apparent anomaly, the histogram charts for each item corroborated the curve of the pointed tools.

In order to reduce quantification error as much as possible, we utilized only the data from Seasons I and II at Shanidar Cave. Bedrock was reached in Season II. In Seasons III and IV, excavations in Layer D were limited to the upper areas only. It is to be noted again that the upper limits of the excavation encompassed a greater volume of sediment than the lower shaft to bedrock. To correct for this in the analysis, we delimited the study zone to the area from bedrock to the top of Layer C in a kind of column-shaped shaft (ca. 160 m^3). This eliminated the problem of overrepresentation of the upper portions of Layer D. We made a composite of "battleship" curves (see Fig. 4.10), based on the counts in each of five categories (tools, debitage, animal bones, pointed tools, and hearths). It immediately shows some interesting correlations. Additionally, these "battleship"-curve graphs combined with other cultural and non-cultural data give us some revealing insights into the occupation of Shanidar Cave during Mousterian times.[1]

The seeming aberrancy in the hearths curve between Levels 24 and 27 (see Fig. 4.10) has, we think, a very simple explanation. There were hearths missing in the record because dead hearths had been trafficked over and destroyed in the process. The charcoal, ashes, and burned earth were encountered in the excavation, but scatter could not be tied to any particular hearths. Taken all together, the graphs illustrate a heavy zone of occupation

between Levels 24 and 33.

The "waisting" of the individual "battleship" curves may be explained by non-cultural factors. The rockfalls present in the section had a definite effect on the quantity of cultural data because, obviously, large rockfalls displaced habitable zones. Thus, the "waisting" of the shape of the curve in Layer 4D may be attributable to rockfalls. The nearly archaeologically sterile horizons of Layers D5–7 may also have been caused by the heavy rockfall that occurred during that period. The Mousterian deposits were effectively sealed by a series of huge rockfalls in the upper part of Layer D1.

It is quite likely that a number of rockfalls may have been precipitated by the onset of cooler and wetter climates. Tectonic activity (the Zagros area is in a very active earthquake zone) undoubtedly was also a cause of some of the roof collapses. Other rockfall includes the boulders that must have fallen in from the overhang at the cave mouth. We heard rocks tumbling down the precipice on a number of occasions while we were at Shanidar Cave.

Regarding the occupation of Shanidar Cave as seen from our excavation and the "battleship" curves, we believe that during Layers D5–7 (to bedrock), Shanidar Cave was visited by itinerant hunter-forager Neanderthals, who probably visited the cave on seasonal rounds. These were probably males. During Layer D4, with some vicissitudes of occupation, Shanidar Cave saw markedly intensive use, very likely as a base camp. We note that the tool inventory from Layer D4 includes flints that may be said to be part of a base camp tool kit. These include limaces, 75% of which come from Layer D4. Perforators have a frequency of 67% in Layer D4 (none below Layer D5). Most pointed flakes are from Layer D4, and twenty-two out of twenty-five Type 69 tools come from Layer D4. Capping the suggestions of high community activity in Layer D4, we have the presence of a deep pit containing burned traces extending the full depth of this layer. From its size and depth, it looks as though it had been a pit roast of some large animal.

Substantiation for the excellent probability that we have a base camp situation in the central heavily dark-stained deposits of Layer D (D4) is found in another direction, the hominid remains. Of the nine Neanderthal skeletons recovered in the Mousterian deposits, an apparent population dichotomy exists. In the upper part of Layer D (D1), we have three adult males (Shanidar I, III, and V), all accidentally killed under rockfalls. Shanidar I and V appeared to be having a meal of fire-cooked turtle when they died. They were killed across the hearth from each other. The other Neanderthals were recovered in the dark-stained occupation zone, D4. The Shanidar baby or child, less than a year old, evidently had been buried in the occupation deposits. Shanidar II, a single male individual, had been killed under a rockfall. Shanidar IV, another male, was found in a flexed position in a kind of crypt among the rocks, associated with the skeletal remains of an adult female, a young adult female, and a child (Trinkaus 1983).

Our interpretation is that the remains of Shanidar Neanderthals I, III, and V were members of roving hunter-forager groups, who used Shanidar Cave as a way station on a seasonal round. On the other hand, the remains of the Neanderthals found in the heavily organic stained area, Layer D4, represents more of a family situation, with children and two females in the group. The fact that we appear to have two burial situations in the cave further adds to our belief that Shanidar Cave was a true base camp during this period (D4), about an estimated 60,000 years ago.

TOOL TYPES

The senior author has published several preliminary papers incorporating discussions of the Mousterian artifacts from Shanidar Cave (R. S. Solecki 1955, 1963, 1971). Two summaries have been published by other investigators (Skinner 1965; Akazawa 1975). The present paper is based on an attribute analysis study of 798 Layer D retouched tools, including 678 from the main collections in the Iraq Museum and 120 in the United States. Skinner's study was based on 571 tools from both collections, and Akazawa's on 714 pieces in the Iraq Museum. However, Akazawa (1975:7) included 147 specimens, which he says "have more or less traces of edge retouch from secondary use."

The focus of this chapter is on the pieces with pointed ends, which make up the most abundant class (381, or 48%) of Mousterian tools at Shanidar Cave. For ease of description, we have

followed Bordes's (1961) typology in this study, with additions and modifications. Seven attributes were selected for analysis in this study: Bordes's tool type, butt type, post-removal butt modification, greatest length, greatest width, greatest thickness, and stratigraphic depth.

A brief summary of our typology is necessary, especially when we diverge from or add to the Bordes system. The attribute of type was used as a convenient preliminary classificatory device, even though lithic typologies have obvious problems and weaknesses. Chipped stone tools must have working edges (ends) in functional good order, and therefore, resharpening/reshaping is usually necessary (raw material availability is a factor here). Repeated edge or point rejuvenation can change the shape of the tool and also even its potential function. Tool breakage and reuse can also affect the typology. Function cannot necessarily be directly inferred from typology. Microscopic use-wear analyses are important in functional studies. These have not, as yet, been done on the Shanidar tools. Researches on other Mousterian assemblages have shown that tools were often multipurpose (Panagopoulou 1985; Shea 1989a, 1989b). The tools described in this paper, however, have at least one pointed end, which could have been used for piercing, graving, or reaming purposes. Tools with sharp pointed ends are not particularly useful for cutting/slicing, and in fact could have posed a real hazard in skin scraping. Other parts of these tools could have been and probably were used for other purposes.

The Shanidar pointed tool types are as follows:

POINTS

(Figs. 4.1, 4.2, 4.3a-e, 4.4a-f, h, 4.5a-h, 4.6a-e, g, h)

Two hundred forty-seven such tools were studied. These include Bordes's Types 6 and 7 Mousterian points, and other points that could not be fit into these (Table 4.2). The Shanidar Cave points were further subdivided on the basis of tip shape, size, and type, and extent and position of retouch. The Shanidar Cave Mousterian points have, as previously noted (R. S. Solecki 1955; Skinner 1965; Akazawa 1975), a high frequency of asymmetric tips angled or curved either to the left or the right. Forty-three percent of all the Mousterian points in this study have asymmetric tip ends. This attribute, however, was present in most of the Mousterian occupation, with no evident temporal concentrations. Tip shape is ultimately related to the sharpening and resharpening of the point, and the Zagros Mousterian people followed a technology (at least just before the tool was abandoned) that produced numbers of points with asymmetric tip ends. Other regional Mousterian variants solved point sharpening/resharpenings in other ways.

The point types are briefly described below:

Type 6 Mousterian Points (Figs. 4.1, 4.2a-e, g, i, 4.3a-e, g-k, 4.5f-g, 4.6a, c-d, h-i): 145 examples were studied, of which 96 (66%) were standard-sized (subtypes 6a-f) and 45 (34%) were classified as small-sized, under 35 mm in length (subtypes 6g-i). The former average 43.1 mm in length, 24.3 mm in width, and 8.0 mm in thickness. The latter are 29.9 mm in length, 19.5 mm in width, and 6.3 mm in thickness (Table 4.3).

Most (74%) of the standard-sized Type 6 Mousterian points fit into Bordes's classic type, but separated out were such minor subtypes as points with retouch located on only one lateral edge (subtype 6c); points with bifacial retouch (subtype 6d); and points with alternate retouch (subtype 6e). The small-sized Type 6 Mousterian points (subtypes 6 g-i) were also divided on the basis of tip symmetry and position of retouch.

Stratigraphical and technological differences between the regular and small-sized Type 6 Mousterian points seem to be indicated (Table 4.2). The smaller points are more concentrated in the upper portions of the Mousterian occupation.[2] Technologically, there are minor differences in butt types, but in all Type 6 points, faceted butts are the most common (Table 4.4). The small-sized Type 6 points, however, have noticeably more examples of pieces with post-removal butt modifications (Tables 4.5–4.7).

Type 7 Elongated Mousterian Points (Figs. 4.4a-f, 4.5a-e, h): 55 tools were classified in this type. These were subdivided into points with symmetric tips (subtype 7a—44%), points with asymetric tips (subtype 7b—52%), and points retouched on only one lateral (subtype 7c—4%). The subtype 7c points were separated from the other Type 7 examples on the basis of stratigraphy and retouch position. There are only two type 7c points and both come from the base of Layer C, a zone containing a small number

of other Mousterian points. They were made on blades, and have heavy retouch down only one lateral (although one has a little retouch at the tip on the other lateral and also extensive ventral retouch). In both, the non-heavily retouched side is a natural blunt edge, suggesting that the points were made on side core trimming pieces. In both cases, the butt had been removed, and the edge thus created was faceted, but not used for flake removal.

Most of the Type 7 Mousterian points fit well into Bordes's definition. They average 50.8 mm in length, 18.7 mm in width, and 7.6 mm in thickness (Table 4.3). In butt type, they are predominantly faceted (70%), with plain butts about 25% and all other types minor (Table 4.4).

Type 66 Inverse Retouched Points: There are only two examples of this type, both from deep in Layer D. The points were formed through inverse retouch on the left lateral. As there is no retouch on the dorsal face, these points were not included with the Mousterian points. They average 39.1 mm in length, 23.1 mm in width, and 5.5 mm in thickness. Both have dihedral butts.

Type 72 Pointed Flakes and Blades (Fig. 4.2f): This term is applied to a variety of pointed pieces. It includes pointed flakes and blades with minimal retouch on the sides or the tip to regularize the shape or make the tip. They average 44.2 mm in length, 21.2 mm in width, and 6.6 mm in thickness (Table 4.3). They lack the heavy and extensive retouch of the Mousterian points. The retouch is usually on the dorsal face, but there are some rare examples with dorsal and ventral retouch, and a few have extensive ventral retouch. Faceted butts occur with about twice the frequency of the next most common types, plain or dihedral (Table 4.4). Only pieces with definite pointed tips were placed in this type, and if the retouch was denticulate/nibbling, the tool was called a denticulate. Forty-four pieces were classified as Type 72, not a very large number (18% of all points). They were more or less regularly distributed in Layer D, except that none occur at the very top or the very bottom of the Mousterian occupation (Table 4.1).

Type 76 Shanidar Point: There is only one example of this point type, from near the top of Layer D. It looks like a Falita/Gravette Point, and may be intrusive in Layer D. We have called this the Shanidar Point. It measured 34.5 mm in length, 12.4 mm in width, and 4.1 mm in thickness.

Type 69 Blunted Points (Figs. 4.3f, 4.4g, i, 4.5i, 4.6b, e-g): There are 25 examples of this type. They look like Mousterian points, but have blunted tip ends, with abrupt sides and some faceting or retouch. The problem, obviously, is to differentiate between the discarded points with accidentally blunted tips and those in which the blunted ends were used in some way. The pieces we classified as Type 69 have faceting/retouch across the blunted end, which distinguishes them from simple snapped pieces. These tools average 51.0 mm in length, 24.5 mm in width, and 7.9 mm in thickness (Table 4.3). They are, therefore, slightly larger in all dimensions than the Type 7 (Elongated) Mousterian points. Perhaps the tips of these specimens were too narrow and steep-sided to be resharpened, or perhaps the strong blunt tip ends served some specialized (e.g., reaming/enlarging) functions.

None of the Type 69 tools have postremoval butt modification. The butt type distribution is as follows (Table 4.4): plain (4), dihedral (3), faceted (8), faceted and plain (1), crushed and plain (1), cortex and plain (1), and indeterminate (5). No Type 69 tools were found below Layer D 5, and only 3 (12%) are from the upper Mousterian layers (Table 4.1).

Type 8 Limaces and Type 74 Single Pointed Limaces (Fig. 4.7): There are 6 limaces (Bordes's Type 8), 20 complete Single Pointed Limaces (Type 74), and 19 broken examples of such tools. Although the distribution range of the limaces is similar to the Mousterian points, 34 (75%) of them were found in Layer D4 (Table 4.1). All the tools classified as limaces are characterized by high, heavily stepped sides, even with undercut edges. The narrower specimens, especially those with undercut edges, probably represent the final stages of tool reduction. The retouched pointed ends are also heavily stepped, and vary in outline from pointed to more rounded, irregular, or even blunt shapes. The profile of the retouched ends can vary from keeled to snouted or blunted. The blanks used to make these tools must have been purposely chosen because of their thickness. Most likely they were made on thick flakes, but side core trimmed pieces or core fragments can also be suggested. These tools are considerably thicker than all the point types and also the converging side-scrapers (Table 4.3). The tools called Single Pointed Limaces (Type 74) share so many attributes (e.g., thick blanks; extensive, high-stepped, even undercut retouch; tips with blunted profiles) with the double-ended limaces (Type 8) that we believe they belong to the same class of tools and were probably used for similar

functions.

Type 8 Limaces (Fig. 4.7a-d): There are 6 complete pointed specimens in the Shanidar Cave collections, which fit into Bordes's Type 8. These average 53.3 mm in length, 15.7 mm in width, and 10.6 mm in thickness.

Type 74 Single Pointed Limaces (Fig. 4.7e-k): There are 20 complete examples of this type. The non-pointed end was either the butt of the original blank (11 examples) or a straight blunt snapped end (9 examples). There were so many examples of this latter type with blunt snapped ends, and they so closely resembled the pieces with straight plain butts, that we believe the Mousterian knappers were probably purposefully preparing these blunt ends. Only one Type 74 example has post-removal butt modification (ventral thinning), despite the fact that these tools were made on selected thick blanks. The tools that still retain the butts were classified as follows: plain butts (2), faceted butts (2), and faceted and plain (2). The tip ends of these tools, like the Mousterian points, may be symmetric or asymmetric in top view. The Type 74 tools are distinguished from the Mousterian points by the thickness of the blank and the corresponding height and stepped quality of the retouch, plus the high or blunt tip end profile that makes it difficult to think of them as projectile points. Bordes (1961: Pl. 12, No. 4) illustrates one of these tools as a "Pointe moustérienne allongée passant à racloir convergent à cause de son épaisseur." We do not think that these should be classified as converging side-scrapers because well-defined points were made.

Types 18–20 Converging Side-Scrapers: Seventeen tools were classified as converging side-scrapers. They were randomly distributed in Layer D, with no evident concentration. Tools were placed in this category rather than with Mousterian Points or Single Pointed Limaces because they did not exhibit a definite pointed end. The tools in this type converge to a rounded or even slightly blunted end, but without the retouch characteristic of Type 69. Five of the converging side-scrapers have snapped/broken or crushed butts; 4 have plain butts; 2 are dihedral; 2 are faceted; 2 are plain and faceted; and 2 are retouched (Table 4.4). The last were either thinned ventrally and dorsally at the butt, or that end was faceted and used as a striking platform. Asymmetric as well as symmetric tip ends are present. The converging side-scrapers average 51.0 mm in length, 26.2 mm in width, and 9.0 mm in thickness (Table 4.3).

Type 34 Perforators (Fig. 4.8a-g): These are included in this paper because they, too, by their very nature must have at least one pointed end. But more than that, two of the perforator subtypes (a and b) here outlined resemble the Mousterian points, and may represent the last stage of tool rejuvenation. The perforators were distinguished from the Mousterian points by the following characteristics (although overlap is possible):

1. Evident narrowing toward the pointed end, separating it from the sides, and often resulting in the creation of a shouldered piece. We could take length measurements of a separate projection (tip length) for the perforators.

2. Special care seems to have been taken in retouching the tip, but in general less care was taken with the rest of the piece. Sometimes there is abrupt retouch at the sides near the tip.

Forty-five pieces were classified as perforators, with the highest concentration in Layer D4 (67%) and none found below Layer D5. The perforator subtypes may be briefly outlined as follows:

Subtypes 34a and 34b (Fig. 4.8a-d): These closely resemble Mousterian points, and are distinguished from each other by retouch position. Subtype 34a perforators (18 examples) are retouched down both laterals, while the subtype 34b tools (7 examples) have retouch down only one lateral. The tips of these pieces may be roughly in the center of the tool (more common) or placed either to the left or right of the center. Asymmetric tips are more numerous than symmetric ones, and the tip ends often have the same composite outline (i.e., a break in the side contour just before the tip) noted in the Mousterian points. None of these tools have post-removal butt modification. Butt types are as follows: cortex (1), plain (4), dihedral (1), faceted (12), crushed (1), faceted and plain (3), and faceted and cortex (l)(Table 4.4). The subtype 34a perforators average 45.6 mm in length, 21.0 mm in width, and 7.4 mm in thickness, while those in subtype 34b average 38.1 mm long, 20.7 mm wide, and 8.1 mm thick (Table 4.3).

Subtype 34c (Fig. 4.8e-f): There are six such perforators. They are shouldered tools with definite projections made by notches on either side of the projection. Sometimes there are sharp shoulders, sometimes less so. Purposeful retouch below the

shoulders is found in only one example. All the tools in this subtype have blunt-ended projections, but whether this situation is due to heavy use or purposeful shaping could not be determined. These tools measure 35.3 mm in length, 19.9 mm in width, and 6.3 mm in thickness (Table 4.3). Two tools have post-removal butt modification. In one, the butt end has been snapped, faceted, and then used as a striking platform. In the other, flakes were removed transversely across the butt. Butt types were as follows (Table 4.4): faceted (2), faceted and plain (1), and retouched (2).

Subtype 34d (Fig. 4.8g): There are thirteen examples in this subtype. This is a catch-all category for perforators with limited and varied retouch. These perforators have the following characteristics: (1) small, restricted tip areas that usually, but not always, can be delimited, and (2) irregular/weak retouch.

Type 21/34 Déjeté Side-Scraper/Perforator (Fig. 4.8h): There are two *déjeté* side-scrapers, which may have been used as perforators as they each have a definite, sharp point at one corner. And in one of these tools, small flakes have been removed from the ventral face at the pointed tip, as if through use. This same specimen has been thinned both ventrally and dorsally at the butt end. Both tools were found in the 8.84 m to 9.15 m level.

POST-REMOVAL BUTT MODIFICATION

The attribute of post-removal butt modification was included in this study because of possible relationships to tool hafting (Tables 4.5–4.7). Thirty-four pieces were recorded in which the butt had been modified after the blank was produced. We do not include here the many pieces with removed/ snapped butt ends, some of which we believe were purposely done (e.g., the examples in Type 74). Also not included here are those pieces in which the butt end was retouched as a tool. The 34 examples of post-removal butt modification found in the pointed tools occur in the following variations:

Post-Removal Butt Modification Types	N	Percent
Thinned on ventral face	5	14.7
Thinned on ventral and dorsal faces	8	23.5
Thinned on ventral face, dorsal face not determinable	5	14.7
Removed, faceted, and used as a striking platform	9	26.5
Removed and faceted	5	14.7
Removed/snapped and used as striking platform	1	2.9
Retouched as continuation of lateral retouch	1	2.9

Pieces with thinned butt ends (ventral, or ventral and dorsal) are the most common types (18 or 52.9%), but almost as numerous are the truncated-faceted pieces (14, or 41.2%). Looking more closely at the correlations between tool type and post-removal modification types we can point out the following:

1. For the points (Table 4.6), we find that this attribute is most frequently found with the small Type 6 Mousterian points (48%), followed by the standard Type 6 Mousterian points (24%), the Type 7 Mousterian points (20%), and the Type 72 points (8%). When we look at the point types in relation to the two major classes of post-removal butt modifications (i.e., thinned or truncated-faceted), we also find that both of these occur most frequently with the small-sized Type 6 Mousterian points. A correlation between post-removal butt modification (especially thinned butts) and the small-sized Type 6 Mousterian points is therefore suggested.

2. The frequency distributions of the attribute of post-removal butt modification in all the pointed tool types (excluding Type 21/34, for which there are only two examples) provides additional documentation for this study (Tables 4.5 and 4.7). This attribute occurs in greatest actual numbers (12) and percentage (23%) in the small Type 6 Mousterian points, followed by standard Type 6 Mousterian points, and Type 7 Mousterian points (Table 4.4). All the other types of pointed tools contain only one or two examples of post-removal butt modifications, but as the numbers are smaller, the percentages for

individual types could be greater. Some types contain no tools with this attribute (e.g., Type 69 with 25 examples), or only one example (e.g., Type 74 with 20 examples). Therefore, the types called points in this paper, include more examples of pieces with post-removal butt modification than the other pointed tools. It is believed, furthermore, that this is not just a reflection of their greater numbers. Twenty-five points (10.1%) have this attribute out of a total of 247 points. For all the other pointed tools combined, only 6 out of 109 (5.5%) exhibit this attribute. This means that post-removal butt modification is almost twice as common in the tools we classified as points than in the other pointed-ended tools.

SUMMARY OF THE SHANIDAR MOUSTERIAN POINTED TOOLS

Pointed tools represent the most common artifact category in the Mousterian deposits (Layer D) from Shanidar Cave. Such tools have at least one pointed end, and include the following tool types: Type 6 Mousterian Points, Type 7 Mousterian Points, Type 66 Points with Inverse Retouch, Type 72 Pointed Flakes and Blades, Type 76 Shanidar Points, Type 69 Blunted Points, Type 8 Limaces, Type 74 Single Pointed Limaces, Types 18–20 Converging Side-Scrapers, Type 34 Perforators, and Type 21/34 *Déjeté* Side-Scrapers/Perforators. Out of the 798 Mousterian tools studied, some 381 (48%) belong to one of these types (Table 4.1).

We decided to study all of these tools as a group because of their most obvious feature, a converging pointed end. In most cases, the pointed tools were purposely made by retouch, but in some (e.g., the pointed flakes and blades), appropriately shaped blanks were only minimally shaped. Pointed tools could have been utilized for a number of specialized functions not possible to achieve with tools having parallel or expanding sides. Use-wear studies have shown that even though pointed Mousterian artifacts were used for a variety of tasks (Shea 1989a, 1989b), correlation has been suggested between tool shape and tool use: "Levallois points, pointed flakes and pointed blades were the most frequently used and were employed chiefly as hafted projectile points and as cutting tools for butchery" (Shea 1989b:617).

We believe, on the basis of our study of the Shanidar Mousterian tools, that the Neanderthals purposefully made points with specific functions in mind, although they could and probably did use them for other purposes as well. This is indicated by special attention to the tip area, as described below.

As the pointed tools were used, the tip ends became dulled or broken, and resharpening of the tip was obviously necessary. This process has probably contributed, in part, to the number of types and subtypes described in this paper. In some cases (e.g., the Mousterian points, Type 69, and Borer Types 34a and 34b), we may be dealing with a reduction sequence. Briefly, the pointed tool types described in this paper were differentiated as follows:

Points are characterized by a sharp pointed end. In the Shanidar Cave examples, the pointed end is often asymmetric, curved either to the left or the right, creating an actual bend or an angle in the side that can be measured. In the Mousterian points, steeper retouched areas near the tips are often present (related to the thickness or the blank), and such areas can be differentiated from the retouch on the remainder or the sides. There is also often a bend in the contour of the sides just before the tip, and the profile of this tip zone is straight. The most likely explanation is that a definite sharp tip was being prepared, otherwise why change direction and type of retouch precisely at the tip, if only a narrowing of the sides was intended?

The Type 69 blunted points resemble the Mousterian points, but have blunted rather than sharp pointed tip ends, suggesting a reaming rather than a piercing function. Microscopic use-wear studies are necessary to validate this type. It should be noted, however, that Type 69 tools have a somewhat different distribution than the Mousterian points.

There is no problem separating the Double Pointed Limaces (Type 8) from all the other pointed tools. We have defined a new tool type, Single Pointed Limaces (Type 74). Such tools resemble the traditional limaces in blank size and shape, and in type and position of retouch. Type 74 tools could be classified (and probably have been) with either Mousterian points or Converging Side-Scrapers. In fact, as already noted, Bordes (l96l: Pl. 12, No. 4) called such a tool a Mousterian point, but verging on a converging side-scraper because of its

thickness. We do not think that our Type 74 belongs with either of these because of the differences already discussed above.

Converging Side-Scrapers (Types 18–20) do not have sharp pointed distal ends, nor do they have the heavy stepped (sometimes undercut) retouched edges characteristic of the Type 74 tools.

Although some of the perforators (subtypes 34a and 34b) resemble the Mousterian points, they and the more traditional types were classified as perforators because of two attributes: (1) the narrowing of the piece toward the tip end, often creating a separate projection at that end, and (2) noticeably more retouch at the tip than along the rest of the laterals.

The two examples of *Déjeté* Side-Scrapers (Type 21) and Perforators (Type 34) both come from the same depth. They are asymmetric side-scrapers in which one corner has been finished to a point.

We think that it is important to recognize that there is a category of pointed Mousterian tools and that the pointed ends of these tools have as much potential for use as do the side edges, and that use-wear studies from other Mousterian sites (Shea 1988, 1989a, b) have shown that they were used. Furthermore, on the basis of our study of the Shanidar Cave tools, we suggest that points, which represent the most abundant type (65%), can be separated from the other pointed tools (e.g., limaces, converging side-scrapers, perforators). The following attributes separate the points from the other pointed tool types:

1. In many cases, a definite point was created at the tip by a change in the contour of the side just before the tip; this is sometimes accompanied by a change in retouch as well.
2. The greater frequency of pieces with post-removal butt modification (possibly for hafting) in the point types as compared to other pointed tool types.

Also of interest in this discussion is the high frequency of butt modifications (especially thinned butts) with the small Type 6 Mousterian points.

In conclusion, two questions come to mind: why are there so many retouched points, and why are so many tools with pointed ends found in the Shanidar Cave Mousterian lithic assemblages?

The answer to the first query, we believe, is related to the fact that the Levallois technique is virtually absent in the Shanidar Mousterian industry. Not having abundant quantities of large-sized nodules available (they used mainly river pebbles), the Shanidar flint knappers could not regularly use the Levallois technique to produce good-sized pointed flakes with naturally sharp, thin edges. Discoidal cores and globular single or multiplatform cores, often worked down to nubbins, are characteristic. These cores provided blanks of varying shapes and thicknesses that had to be heavily retouched along the edges to make the desired tools.

In answer to the second query, "why so many pointed tools?" we can suggest that, on the very simplest level, the extensive use of the discoidal core reduction technique will produce large numbers of thick pointed flakes. We also suggest, on a somewhat higher level, that so many heavily retouched pointed tools were discarded because they represent the final stage of tool reduction (i.e., they were difficult to further resharpen because of the thickness/bluntness of the edges and the presence of a point at the end of converging sides). Beyond these explanations, however, we would like to suggest that many of these pointed tools from Shanidar Cave were used in the hunt and for the processing of the gains of the hunt.

We believe that Shanidar Cave served as a base camp for Neanderthal man at least part of the time, located as it was close to a permanent water source and good hunting areas. The depositional evidence, as described in the first section of this paper, however, shows that there is considerable variation in the intensity of the Mousterian occupation of the cave.

NOTES

1. We have to note a reservation concerning our findings, because of a bias. As we have stated earlier in the text, our excavation in the middle of the cave area would not have been our first choice. Ideally, an area next to the cave wall should be explored.

2. If size of these points at Shanidar reflects reduction strategies to any extent, then the concentration of the small Type 6 points in the upper portions of Layer D is reminiscent of the increasing intensity of reduction through time documented for the Warwasi Mousterian (see Dibble and Holdaway, this volume).

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TABLE 4.1a. Distribution of Pointed Tool Types in Layer D (Mousterian) at Shanidar Cave.

TYPES	LAYER											
	C/D	D1	D2	D3	D4A	D4B	D4C	D5	D6	D7	?*	T
69	1	1	1	3	6	2	9	2	-	-	-	25
8	-	1	-	-	1	-	4	-	-	-	-	6
74	1	2	-	-	7	4	9	1	1	-	1	26
75	1	1	-	1	2	2	5	1	-	-	-	13
34/1	-	4	2	1	7	2	1	1	-	-	-	18
34/2	-	1	-	-	4	1	1	-	-	-	-	7
34/3	-	1	1	-	2	1	1	-	-	-	-	6
34/4	-	-	1	2	5	3	1	1	-	-	-	13
21/34	-	-	-	-	-	-	2	-	-	-	-	2
18-20	-	3	1	1	2	4	4	1	-	-	1	17
6/7	6	30	10	17	61	30	39	1	-	2	4	200
66	-	-	-	-	-	1	1	-	-	-	-	2
72	-	3	4	3	16	7	10	-	-	-	1	44
76	-	1	-	-	-	-	-	-	-	-	-	1
	9	48	20	28	114	57	87	8	1	2	7	381

*Locus not determinable

TABLE 4.1b. Summary Table of Table 4.1a.

TYPES	LAYER											
	C/D	D1	D2	D3	D4A	D4B	D4C	D5	D6	D7	?*	%T
69	1	1	1	3	6	2	9	2	-	-	-	6.6
8,74,75	2	4	-	1	10	6	18	2	1	-	1	11.8
all 34	-	6	4	3	19	7	4	2	-	-	-	11.8
21/34	-	-	-	-	-	-	2	-	-	-	-	0.5
18-20	-	3	1	1	2	4	4	1	-	-	1	4.5
all points	6	34	14	20	77	38	50	1	-	2	5	64.8
	2.4	12.6	5.2	7.3	30.0	15.0	23.0	2.0	0.2	0.5	1.8	

METERS DEPTH FOR LEVELS AT SHANIDAR CAVE

C/D	3.35–4.00
D1	4.00–5.50
D2	5.50–6.10
D3	6.10–7.00
D4A	7.00–7.95
D4B	7.95–8.85
D4C	8.85–10.06
D5	10.06–10.60
D6	10.60–11.60
D7	11.60–13.42

TABLE 4.2a. Distribution of Point Types in Layer D (Mousterian) at Shanidar Cave.

TYPES	LAYER											
	C/D	D1	D2	D3	D4A	D4B	D4C	D5	D6	D7	?*	T
6a	-	1	1	2	11	5	7	1	-	1	1	30
6b	-	4	1	1	9	3	9	-	-	1	-	28
6c	-	2	1	2	3	2	2	-	-	-	2	14
6d	-	-	-	-	1	-	-	-	-	-	-	1
6e	-	1	-	-	-	4	-	-	-	-	-	5
6f	2	3	2	-	3	3	5	-	-	-	-	18
6g	-	4	-	3	12	-	2	-	-	-	-	21
6h	1	5	1	1	6	4	5	-	-	-	-	23
6i	1	2	-	-	1	1	-	-	-	-	-	5
7a	-	1	-	3	6	3	7	-	-	-	-	20
7b	-	5	1	4	8	3	2	-	-	-	1	24
7c	2	-	-	-	-	-	-	-	-	-	-	2
7d	-	2	3	1	1	2	-	-	-	-	-	9
66	-	-	-	-	-	1	1	-	-	-	-	2
72	-	3	4	3	16	7	10	-	-	-	1	44
76	-	1	-	-	-	-	-	-	-	-	-	1
	6	34	14	20	77	38	50	1	-	2	5	247

TABLE 4.2b. Summary of Table 4.2a.

TYPES	LAYER											%T
standard	C/D	D1	D2	D3	D4A	D4B	D4C	D5	D6	D7	?*	by type
type 6	2	11	5	5	27	17	23	1	-	2	3	38.9
small												
type 6	2	11	1	4	19	5	7	-	-	-	-	19.8
all 7	2	8	4	8	15	8	9	-	-	-	1	22.3
66	-	-	-	-	-	1	1	-	-	-	-	0.8
72	-	3	4	3	16	7	10	-	-	-	1	17.8
76	-	1	-	-	-	-	-	-	-	-	-	0.4
%T by Layer	2.4	13.8	5.7	8.1	31.2	15.4	20.2	0.4	0.0	0.8	2.0	

Point Types:

6a: standard-symmetric tips
6b: standard-asymmetric tips
6c: standard-retouched on one lateral
6d: standard-bifacial retouched
6e: standard-alternate retouched
6f: standard-not subtyped
6g: small-symmetric tips
6h: small-asymmetric tips
6i: small-retouched on one lateral
7a: symmetric tips
7b: asymmetric tips
7c: retouched on one lateral
7d: not subtyped
66: inverse retouched points
72: pointed flakes and blades
76: Shanidar point

*Locus not determinable

TABLE 4.3. Length, Width, and Thickness of Pointed Tool Types in Layer D (Mousterian) at Shanidar Cave.

	LENGTH		WIDTH		THICKNESS		N
TOOL TYPE	mean	s.d	mean	s.d.	mean	s.d.	
Standard Type 6 Mousterian Points	43.1	7.1	24.3	4.4	8.0	2.1	79
Small Type 6 Mousterian Points	29.9	4.5	19.5	4.2	6.3	1.5	46
Type 7 Mousterian Points	50.8	9.7	18.7	2.8	7.6	1.5	46
Type 66 Points	39.1	0.4	23.1	6.2	5.5	0.8	2
Type 72 Points	44.2	11.4	21.2	5.6	6.6	2.2	42
Type 76 Points	34.5	12.4	4.1	1			
Type 69	51.0	10.4	24.5	6.3	7.9	2.6	23
Type 8 Limace	53.3	8.6	15.7	4.8	10.6	2.3	6
Type 74 Single Pointed Limace	45.0	12.1	18.6	3.2	11.5	2.2	20
Type 18-20 Converging Side-Scraper	51.0	12.5	26.2	5.2	9.0	1.6	15
Type 34a Perforators	45.6	10.7	21.0	6.6	7.4	1.4	18
Type 34b Perforators	38.1	6.9	20.7	7.0	8.1	2.8	8
Type 34c Perforators	35.3	5.1	19.9	3.9	6.3	2.2	6
Type 34d Perforators	35.5	7.1	18.9	4.8	5.0	2.0	13
Type 21/34	51.4	3.5	32.1	11.7	12.6	2.3	2

TABLE 4.4. Distribution of Butt Types in the Pointed Tool Types in Layer D (Mousterian) at Shanidar Cave.

BUTT TYPE	TOOL TYPE											
	6&7		72		76		69		74		18-20	
	N	%	N	%	N	%	N	%	N	%	N	%
cortex	2	1.0	2	4.5	-	-	-	-	-	-	-	-
plain	47	23.2	9	20.4	1	100.0	4	16.0	7	35.0	4	23.5
dihedral	21	10.4	8	18.2	-	-	4	16.0	-	-	2	11.7
faceted	63	31.3	14	31.8	-	-	8	32.0	2	10.0	2	11.7
crushed	-	-	1	2.3	-	-	-	-	-	-	-	-
indeterminate	51	25.3	6	13.6	-	-	5	20.0	9	45.0	7	41.2
faceted and plain	13	6.4	4	9.1	-	-	1	4.0	2	10.0	2	11.7
crushed and plain	2	1.0	-	-	-	-	1	4.0	-	-	-	-
cortex and plain	1	0.5	-	-	-	-	2	8.0	-	-	-	-
retouched and plain	1	0.5	-	-	-	-	-	-	-	-	-	-
faceted and cortex	-	-	-	-	-	-	-	-	-	-	-	-
Total	201		44		1		25		20		17	

TABLE 4.4. Distribution of Butt Types in the Pointed Tool Types in Layer D (Mousterian) at Shanidar Cave (continued).

BUTT TYPE / TOOL TYPE	34/1&2		34/3		34/4		21/34	
	N	%	N	%	N	%	N	%
cortex	1	4.0	-	-	-	-	-	-
plain	4	16.0	-	-	3	23.0	-	-
dihedral	1	4.0	-	-	-	-	-	-
faceted	12	48.0	2	33.3	2	15.4	-	-
crushed	1	4.0	-	-	-	-	-	-
indeterminate	2	8.0	2	33.3	4	30.8	2	100.0
faceted and plain	3	12.0	1	16.7	3	23.0	-	-
crushed and plain	-	-	1	16.7	1	7.7	-	-
cortex and plain	-	-	-	-	-	-	-	-
retouched and plain	-	-	-	-	-	-	-	-
faceted and cortex	1	4.0	-	-	-	-	-	-
Total	25		6		13		2	

TABLE 4.5. Distribution of Post-Removal Butt Modification Types in the Pointed Tool Types.

Type of Post-removal Butt Modification		STD 6	SML 6	BKN 6	7	66	72	76	69	8	17	18-20	34	21/34	totals
thinned on ventral face		-	3	-	1	-	1	-	-	-	-	-	-	-	5
thinned on ventral and dorsal faces		2	2	1	-	-	-	-	-	-	1	1	-	1	8
thinned on ventral face; dorsal indet.		1	2	-	-	-	1	-	-	-	-	1	-	-	5
removed, faceted and used as striking platform		2	4	2	-	-	-	-	-	-	-	-	1	-	9
removed and faceted		-	-	-	4	-	-	-	-	-	-	-	1	-	5
removed/snapped and used as striking platform		1	-	-	-	-	-	-	-	-	-	-	-	-	1
retouched as continuation of lateral retouch		-	1	-	-	-	-	-	-	-	-	-	-	-	1
Totals	N	6/80	12/52	3/6	5/55	0/2	2/44	0/1	0/25	0/8	1/20	2/17	2/45	1/2	34
	%	7.5	23.0	50.0	9.1	0.0	4.5	0.0	0.0	0.0	5.0	11.7	4.4	50.0	

TABLE 4.6. Distribution of Post-Removal Butt Modification Types in the Point Types.

MODIFICATION TYPE	POINT TYPE												
	STD 6		SML 6		7		66		72		76		totals
	N	%	N	%	N	%	N	%	N	%	N	%	
all thinned types 1,2,3	3	23.1	7	53.8	1	7.7	-	-	2	15.4	-	-	13
all removed/ faceted types 4,5	2	20.0	4	40.0	4	40.0	-	-	-	-	-	-	10
removed, snapped, used as striking platform type 6	1	100.0	-	-	-	-	-	-	-	-	-	-	1
retouched as continuation of lateral retouch type 7	-	-	1	100.0	-	-	-	-	-	-	-	-	1
Totals	6	24.0	12	48.0	5	20.0	0	0.0	2	8.0	0	0.0	25

TABLE 4.7. Distribution of Post-Removal Butt Modification Type Totals in the Pointed Tool Types.

ALL POST-REMOVAL BUTT MODIFICATION TYPES		
TYPE	N	%
STD 6	6	19.3
SML 6	12	38.7
7	5	16.1
66	-	-
72	2	6.5
76	-	-
69	-	-
8	-	-
74	1	3.2
18-20	2	6.5
34	2	6.5
21/34	1	3.2
Total	31	100.0

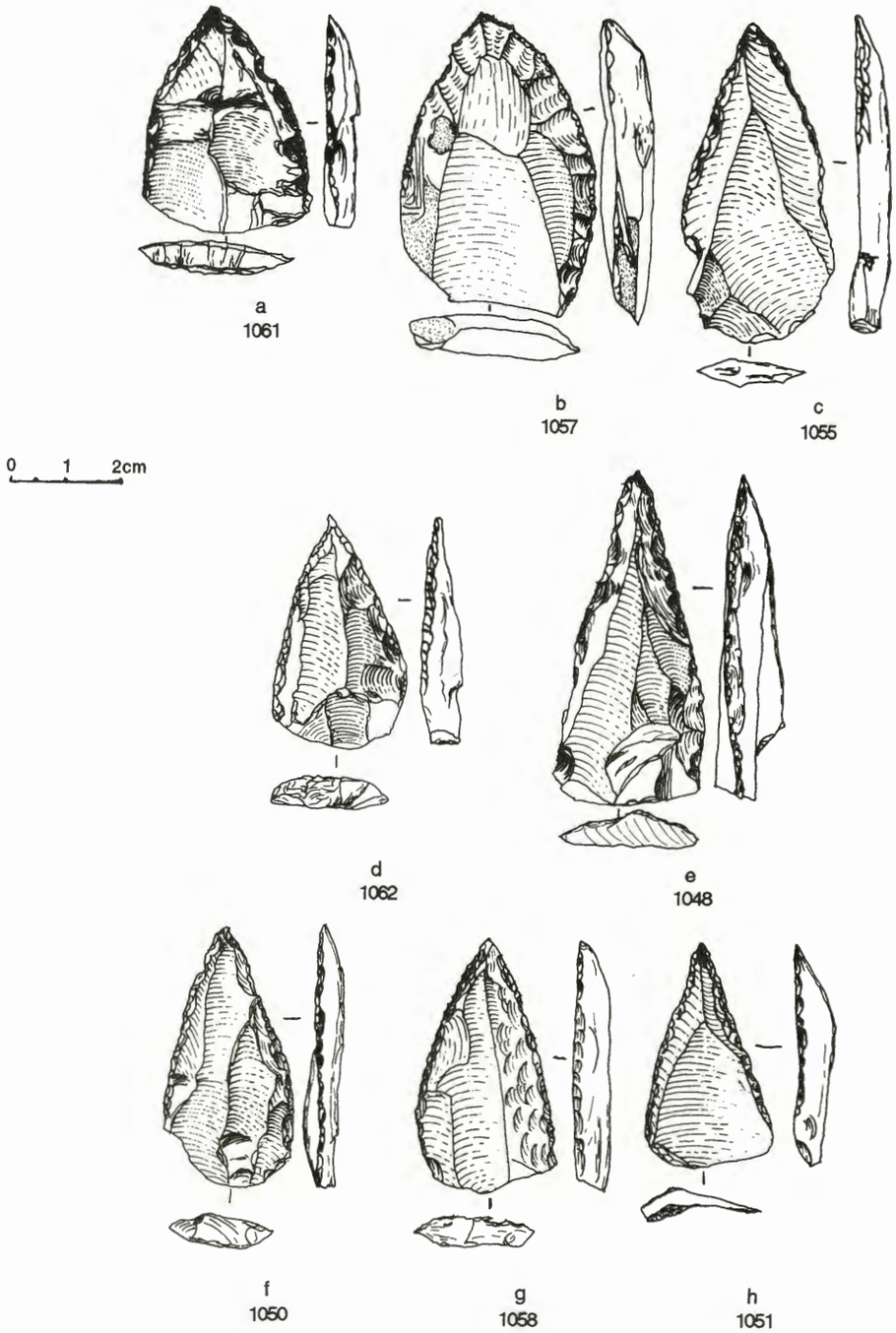

Figure 4.1. Type 6 Mousterian points.

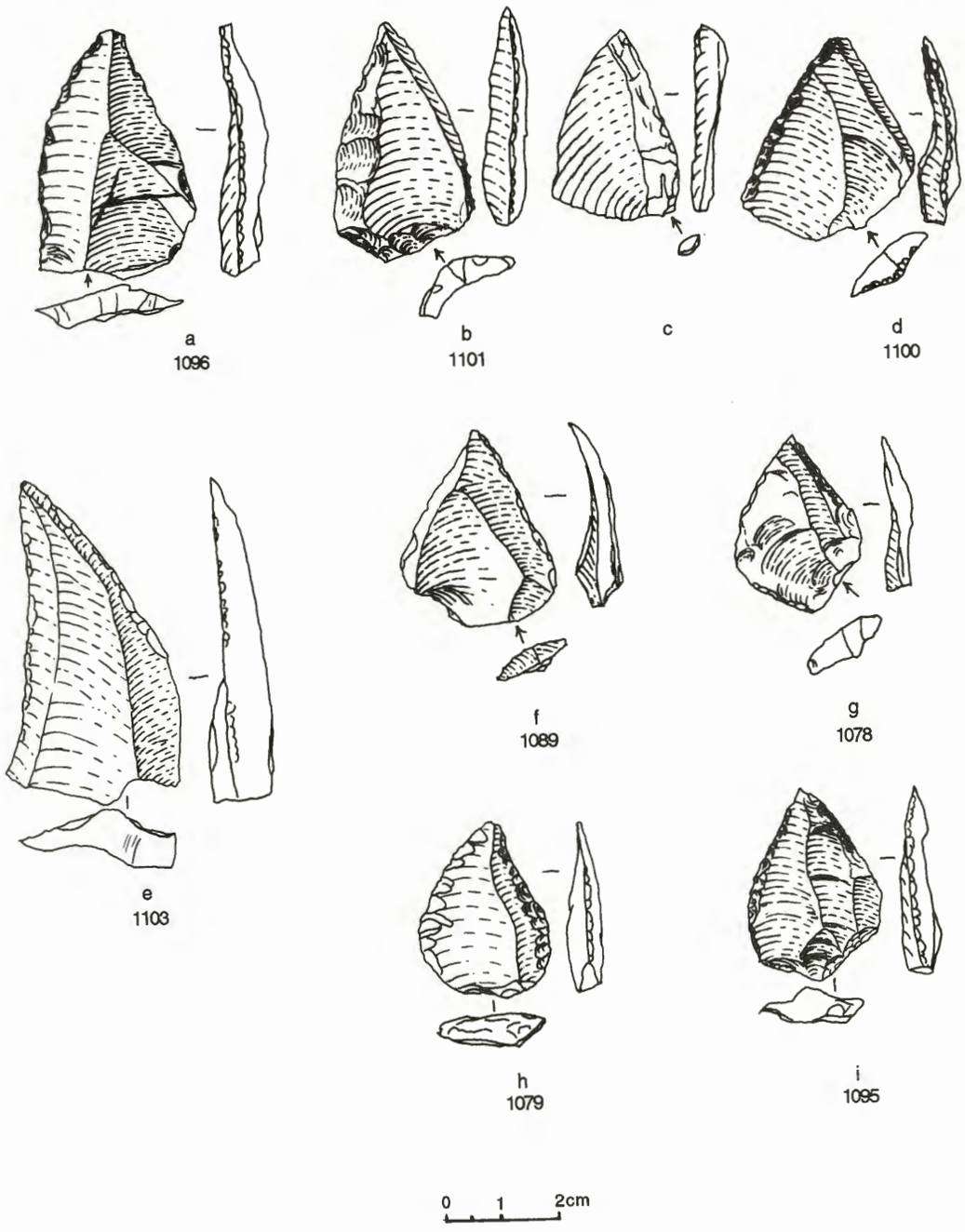

Figure 4.2. *Type 6 Mousterian points: a-e, g; Type 72 pointed flakes and blades: f.*

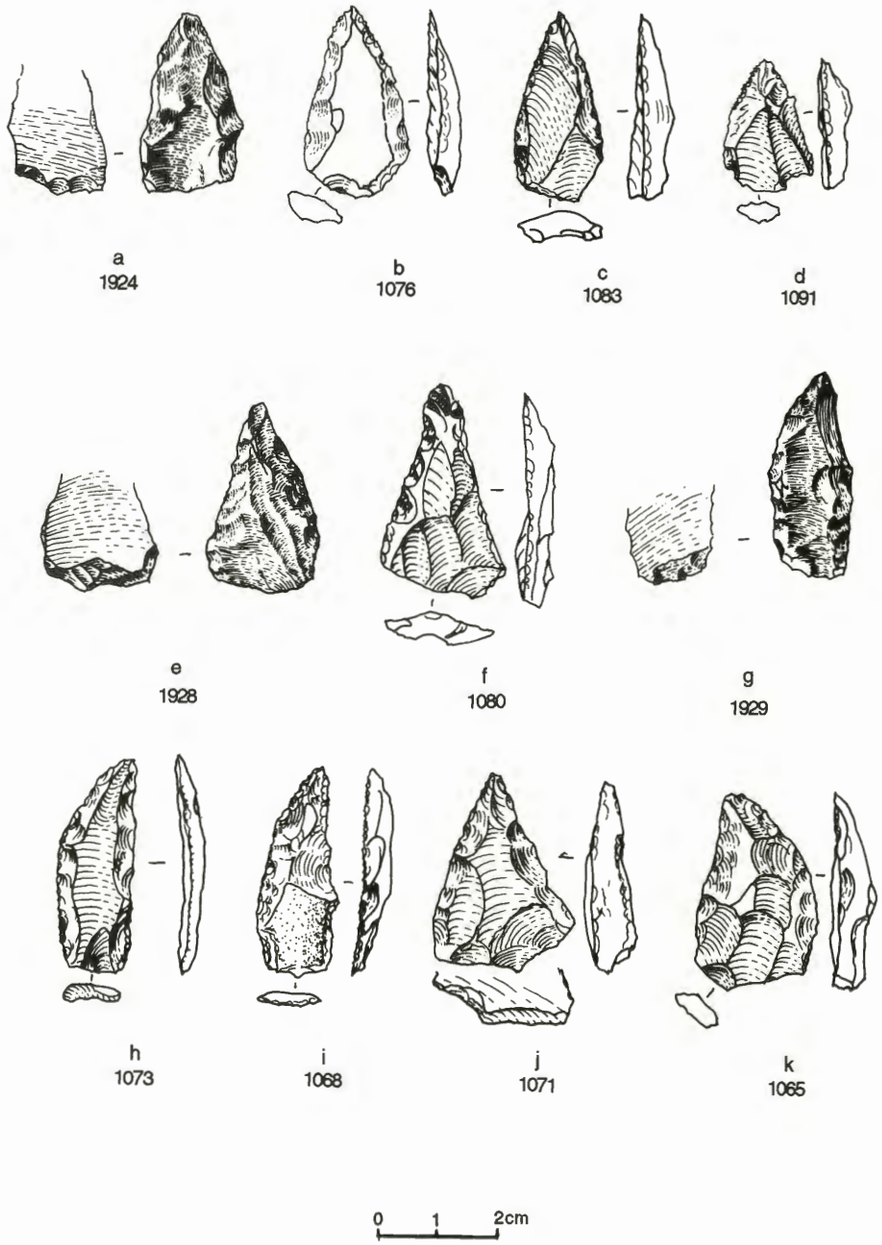

Figure 4.3. *Type 6 Mousterian points: a-e, g-k; Type 69 blunted points: f.*

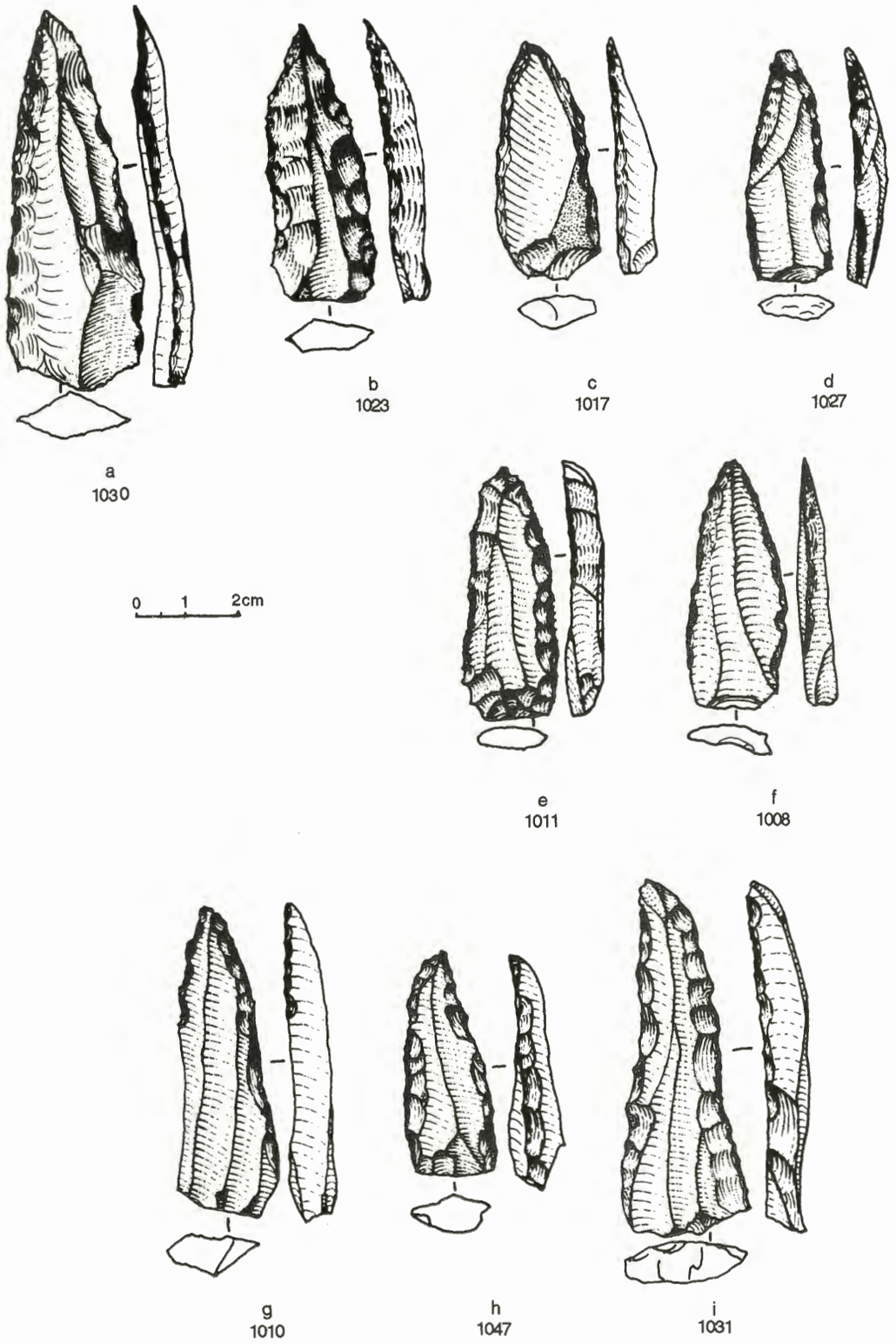

Figure 4.4. Type 7 elongated Mousterian points: a-f, h; Type 69 blunted points: g.

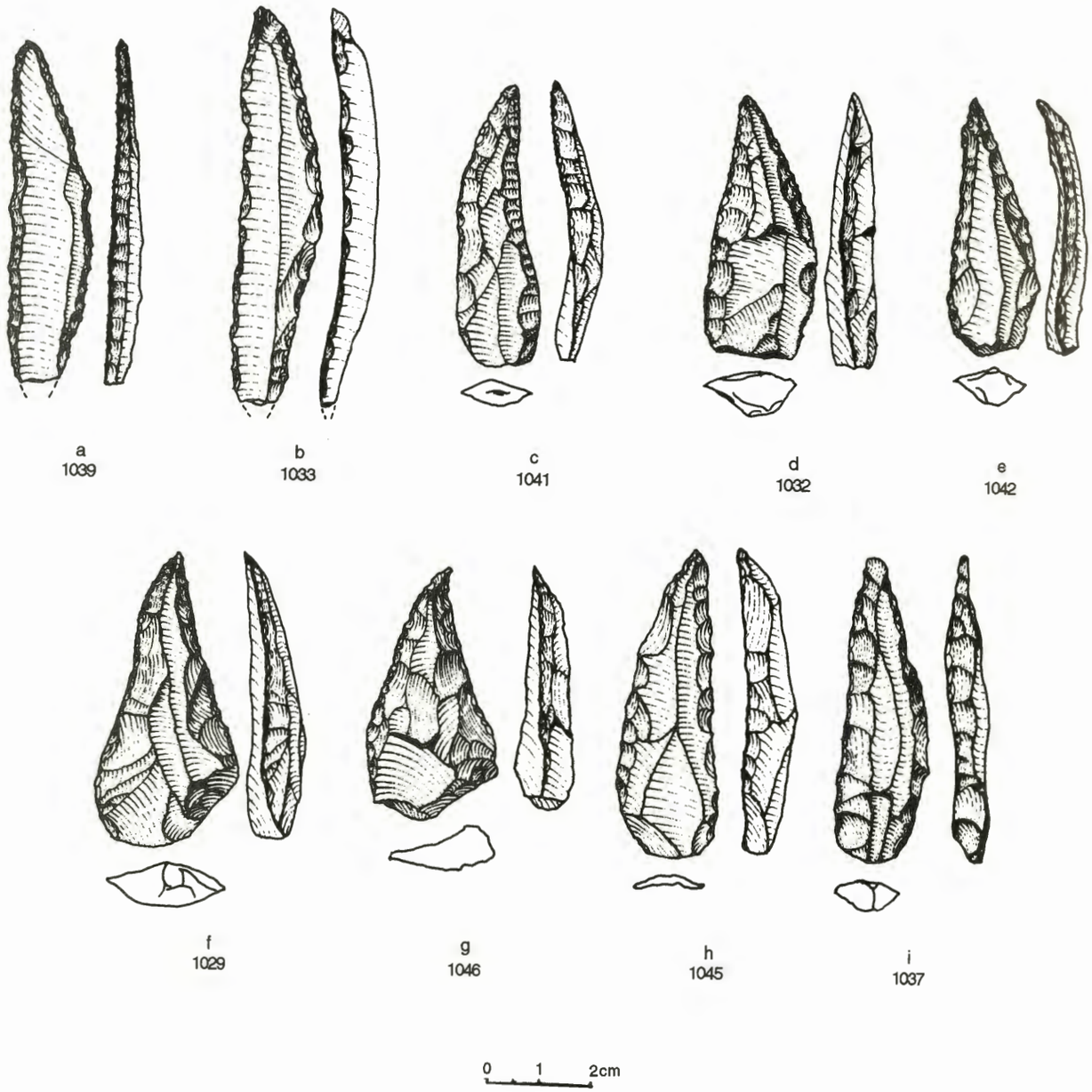

Figure 4.5. *Type 7 elongated Mousterian points: a-e, h; Type 6 Mousterian points: f-g; Type 69 blunted points: i.*

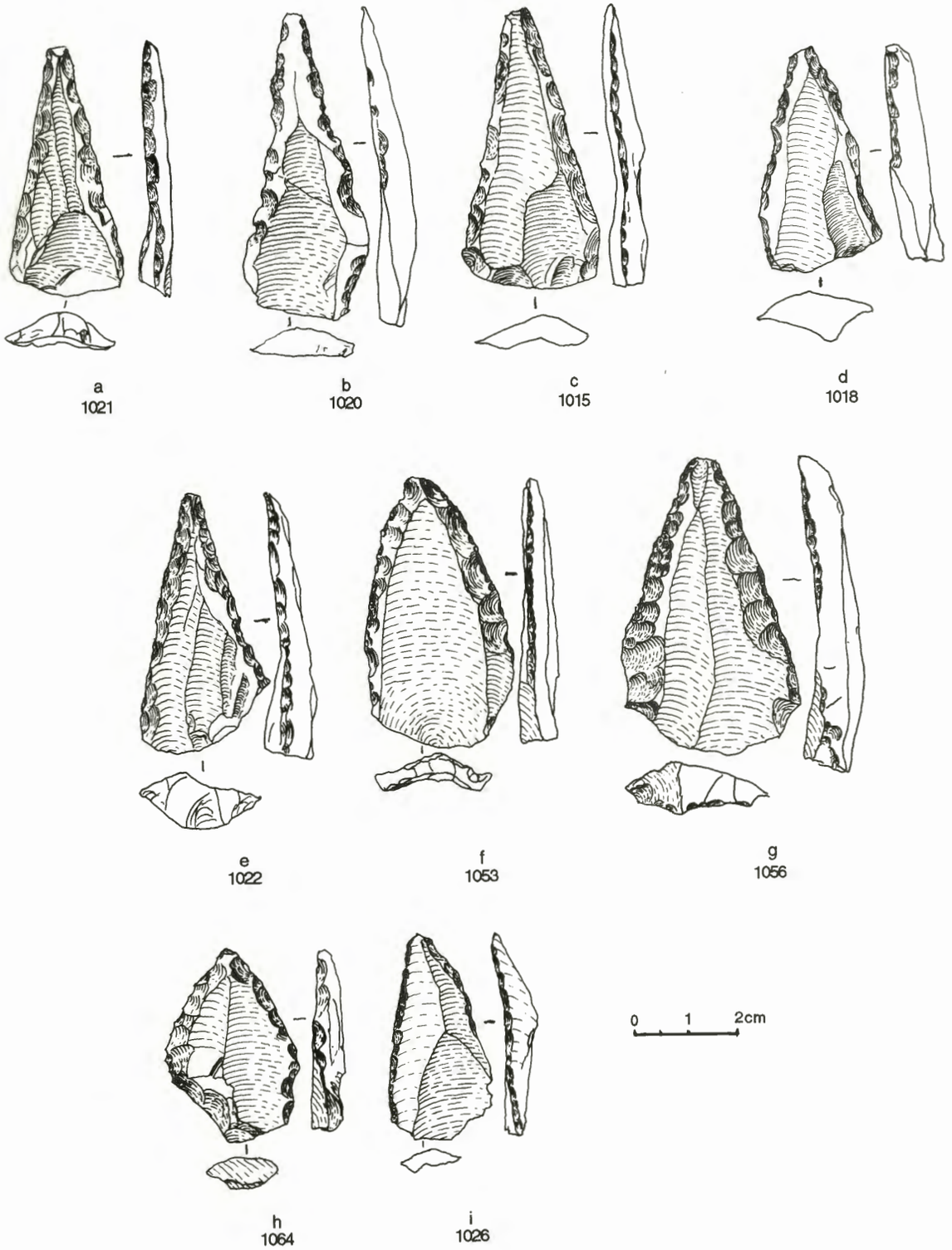

Figure 4.6. Type 6 Mousterian points: a, c-d, h-i; Type 69 blunted points: b, e-g.

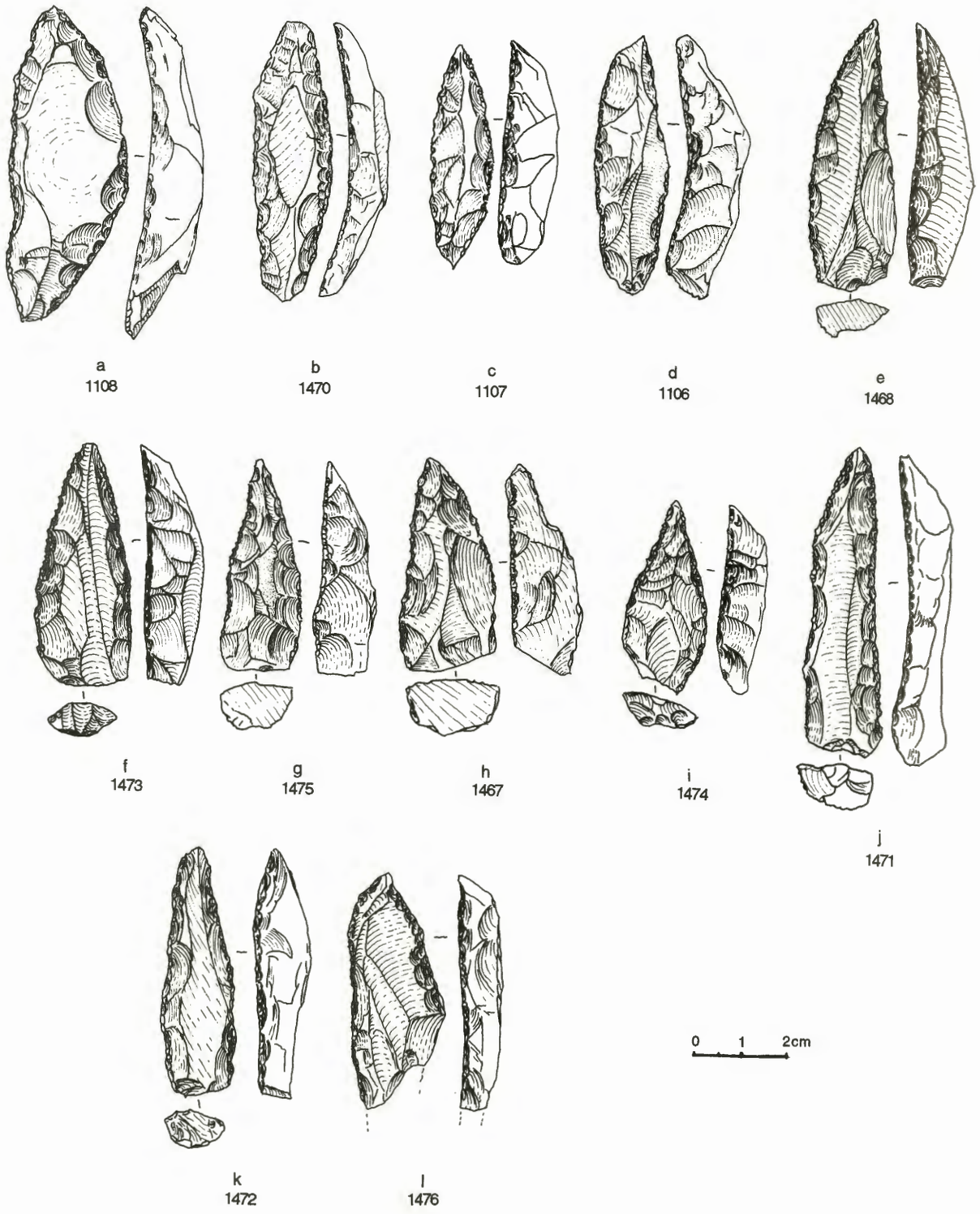

Figure 4.7. *Type 8 limaces: a-d; Type 74 single pointed limaces: e-k.*

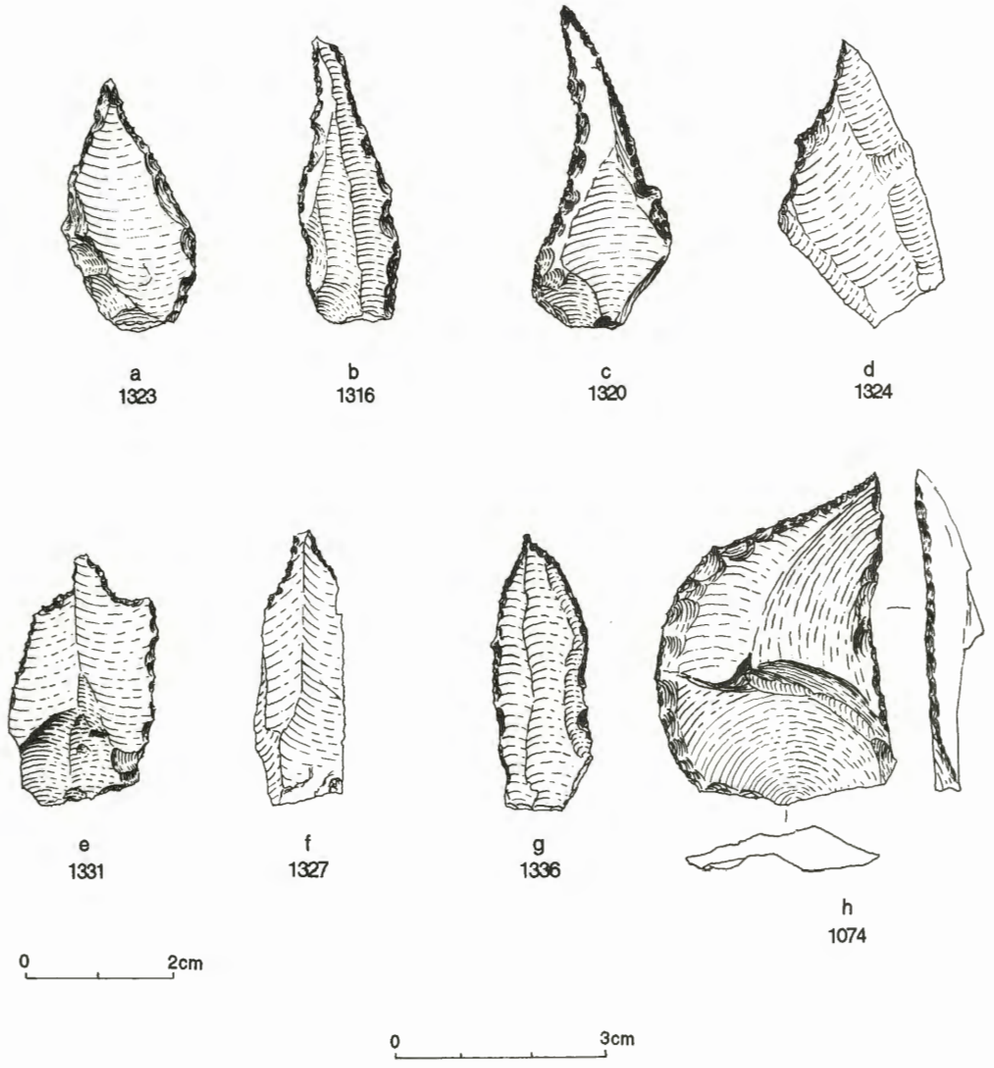

Figure 4.8. Type 34 perforators: a-g; Type 22/24 déjeté side-scraper/perforator: h.

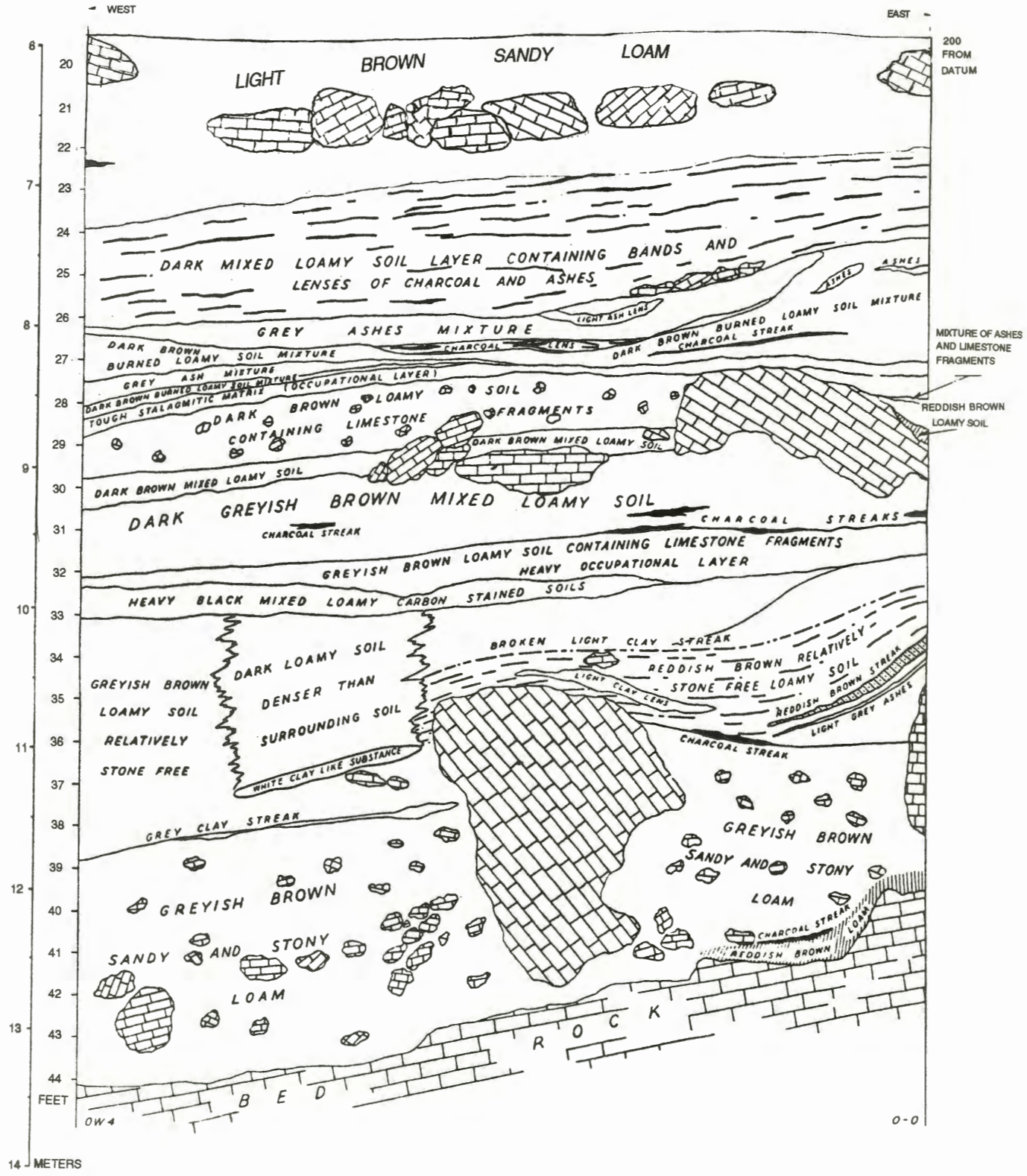
WEST
EAST
200 FROM DATUM
LIGHT BROWN SANDY LOAM
DARK MIXED LOAMY SOIL LAYER CONTAINING BANDS AND LENSES OF CHARCOAL AND ASHES
ASHES
LIGHT ASH LENS
GREY ASHES MIXTURE
DARK BROWN BURNED LOAMY SOIL MIXTURE
CHARCOAL LENS
DARK BROWN BURNED LOAMY SOIL MIXTURE CHARCOAL STREAK
MIXTURE OF ASHES AND LIMESTONE FRAGMENTS
GREY ASH MIXTURE
DARK BROWN BURNED LOAMY SOIL MIXTURE (OCCUPATIONAL LAYER)
TOUGH STALAGMITIC MATRIX
DARK BROWN LOAMY SOIL CONTAINING LIMESTONE FRAGMENTS
REDDISH BROWN LOAMY SOIL
DARK BROWN MIXED LOAMY SOIL
DARK GREYISH BROWN MIXED LOAMY SOIL
CHARCOAL STREAK
CHARCOAL STREAKS
GREYISH BROWN LOAMY SOIL CONTAINING LIMESTONE FRAGMENTS
HEAVY OCCUPATIONAL LAYER
HEAVY BLACK MIXED LOAMY CARBON STAINED SOILS
BROKEN LIGHT CLAY STREAK
GREYISH BROWN LOAMY SOIL RELATIVELY STONE FREE
DARK LOAMY SOIL DENSER THAN SURROUNDING SOIL
REDDISH BROWN RELATIVELY STONE FREE LOAMY SOIL
LIGHT CLAY LENS
REDDISH BROWN STREAK
LIGHT GREY ASHES
CHARCOAL STREAK
WHITE CLAY LIKE SUBSTANCE
GREY CLAY STREAK
GREYISH BROWN SANDY AND STONY LOAM
GREYISH BROWN SANDY AND STONY LOAM
CHARCOAL STREAK
REDDISH BROWN LOAMY
R O C K
B E D
FEET
METERS
OW4
0-0

Figure 4.9a. Cross section of Shanidar Cave sounding on Line 00-0W4 (North Face, Upper Half Section).

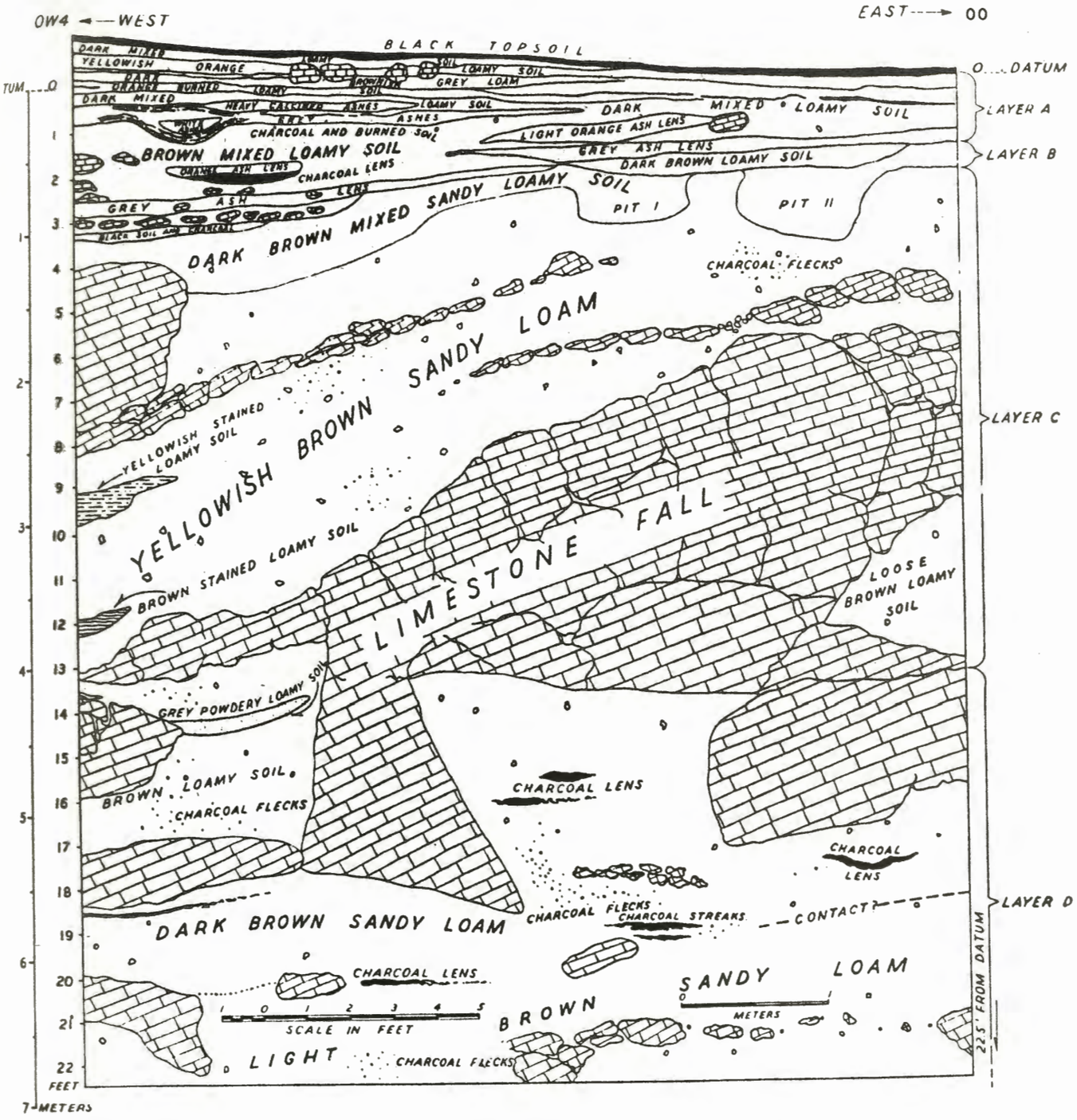

Figure 4.9b. Cross section of Shanidar Cave sounding on Line 00-0W4 (North Face, Lower Half Section).

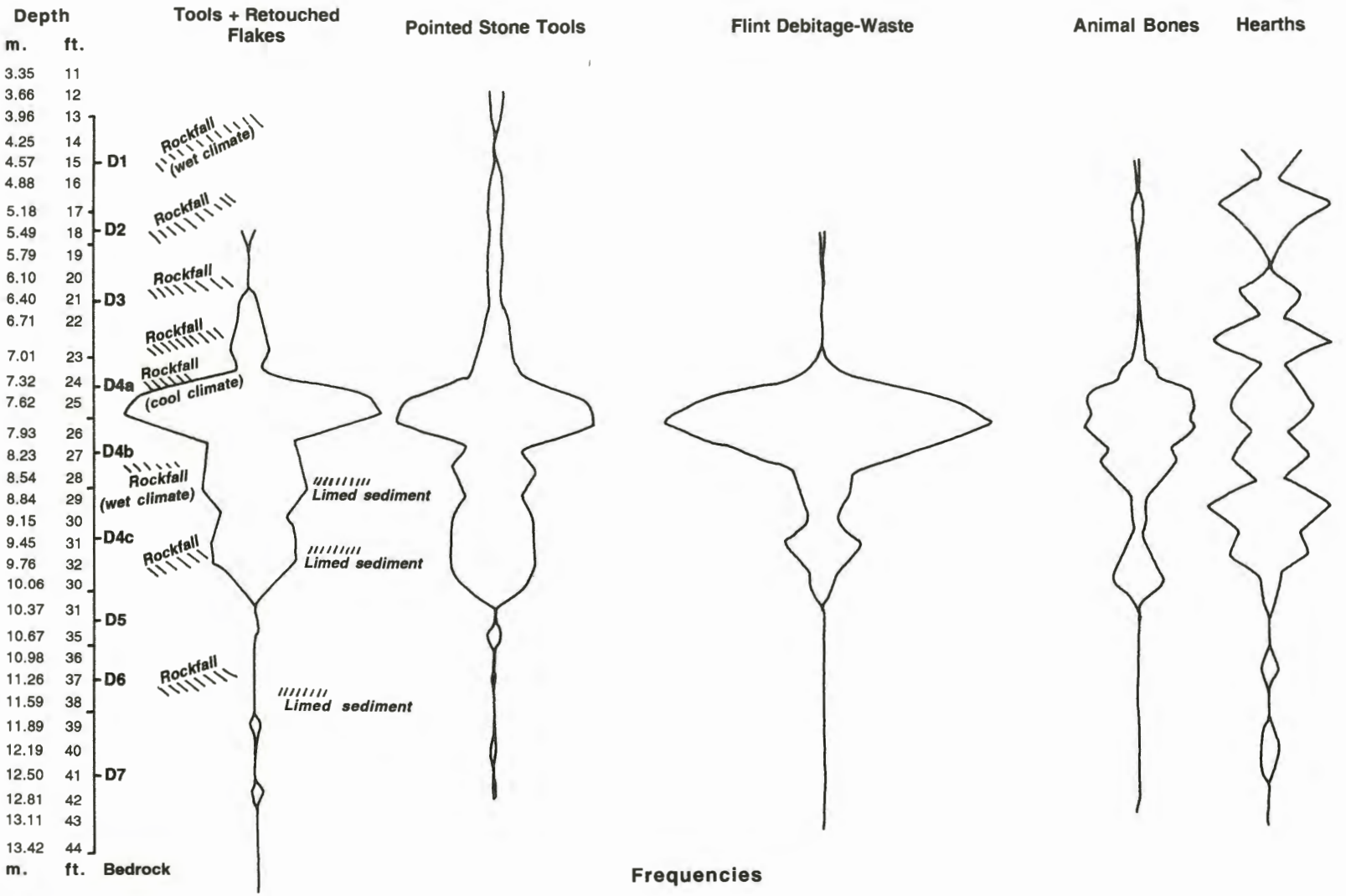

Figure 4.10. Relative frequencies of five cultural features in the Mousterian layers.

5

Middle and Upper Paleolithic in the Taurus-Zagros Region

Angela Minzoni-Déroche

Major drawbacks in the analysis of Paleolithic assemblages from the Zagros and from the Taurus are the general lack of information available and the lack of homogeneity in the information and analysis of the artifacts. Thus, features described for some assemblages are not always presented for other collections, and comparisons therefore have to rely on a very limited number of characteristics. For this reason, arguments forwarded in this paper must be taken as research hypotheses and not as conclusive statements.

For the Taurus Middle and Upper Paleolithic, almost no geostratigraphical, chemical, or physical dating analyses have been done and the chronological attributions are based mainly on the techno-typological characteristics of the artifacts. I am thus aware that I am comparing assemblages that can be chronologically quite distant from one another, even if they are still included in the wider framework of either the Middle or the Upper Paleolithic.

In this paper I utilize the data collected from the study of lithic collections from sites in the Taurus (Kocapınar, Çakmaktepe, and Karain for the Middle Paleolithic; Karain, Oküzini, and Kızılin for the Upper Paleolithic) and in the Zagros (Kunji, Gar Arjeneh, Bisitun, and Shanidar for the Middle Paleolithic; Yafteh and Pa Sangar for the Upper Paleolithic). For comparative purposes, I also mention some sites located on the Mediterranean coast of Hatay (Merdivenli, Kanal, Tikalı, and Üçagızlı) that have different features from the Zagros-Taurus assemblages and that are more similar to Levantine coast assemblages (Fig. 5.1).

MIDDLE PALEOLITHIC (Tables 5.1a, 5.1b, 5.2a)

TAURUS

Çakmaktepe (Minzoni-Déroche 1988).[1] The site consists of several small mounds surrounding the Boz plain, l5 km northeast of Ulukışla, in the Cilician gates, at an altitude of 1000 m (Çakmaktepe is Turkish for "flint mound"). The heavy erosion in this region exposes the natural flint veins to the surface, and as recently as a few years ago local people were using this flint for knapping purposes (tribulum). Artifacts of all kinds are mixed; systematic collection of the flints allowed separation of the modern from the Paleolithic. It appears that Paleolithic knappers selected only the flint without impurities. Among the ninety-six specimens considered Paleolithic were found exhausted discoidal cores, thick and short flakes, and artifacts with continuous retouched edges (Fig. 5.3).

Karain (Minzoni-Déroche and Yalçınkaya 1985).[2] This cave is situated 27 km northwest of Antalya, at an altitude of 440 m. Important collections gathered come from K. Kökten's excavations during the early 1960s; unfortunately, no details about the stratigraphy were published (but see Yalçınkaya et al., this volume).

Unlike Çakmaktepe, where the flint is found as stratified tablets, the artifact raw flint at Karain consists of rounded flint pebbles from

nearby streams. The pebbles are small in size, and of different colors (black or dark red or green). Exhausted discoidal cores are very abundant and few Levallois cores were found. The typology is restricted; the most common artifacts are side-scrapers, continuous retouched flakes, some Mousterian points, and "limaces" (Fig. 5.3).

Kocapınar (Minzoni-Déroche 1987a).[3] The site is situated 1250 m above sea level, on one edge of the Elmalı plain in the Antalya province, some 35 km west from Karain Cave passing through the Bey dağ system. The raw material is flint, which is found as stratified boulders in nearby formations. Although the raw material is abundant, the cores are very often reduced until they can no longer be knapped. The characteristics of the assemblage can be summarized as follows: abundant exhausted disc cores, few Levallois flake cores, a great number of thick flakes; common tools are denticulates, notches, and scrapers (Fig. 5.2). Certain features of these artifacts are shared by the Karain assemblage. One hypothesis might be that Karain Cave was inhabited by seasonal nomads who also lived at open air sites, such as Kocapınar, which is situated on the plains near Elmalı. The few retouched pebbles found at Kocapınar seem to be flat and rolled as sea pebbles, which might be an additional indication that Kocapınar was a temporary site and the inhabitants moved as far as the seashore.

ZAGROS

Kunji (Hole and Flannery 1967; Minzoni-Déroche 1987b; Skinner 1965).[4] The cave is situated in the Khorramabad Valley at an altitude of 1170 m. Although the source of the radiolarite raw material has not been determined, the artifacts appear to be made from small pebbles, possibly from the riverbed. Cores are not abundant, flakes are predominant, and no trace of bipolar flint-knapping was found. The continuous retouched tools are the most frequent; Mousterian points, side-scrapers, and borers are also present (see Baumler and Speth, this volume, for a complete analysis) (Figs. 5.2–5.3).

Gar Arjeneh (Minzoni-Déroche 1987b).[5] The cave is situated near Kunji, in a similar context. The industry is also similar, with numerous continuous retouched artifacts, some Mousterian points, side-scrapers, and borers. The types present are, however, more diverse than at Kunji, and there is a wide range of Levallois technique (cores and flakes), a higher proportion of blades, and thinner and more elongated flakes (Fig. 5.2).

UPPER PALEOLITHIC

The lack of consistency in information available, as seen in the Middle Paleolithic assemblages, is also a problem for the Upper Paleolithic assemblages (see Table 5.2b). Briefly, these assemblages can be summarized as follows:

TAURUS

Karain. There are 375 flakes and blades. This site, described above in the Middle Paleolithic section, apparently has no stratigraphic distinction between the Middle and the Upper Paleolithic (see Yalçınkaya et al., this volume). Unipolar and bipolar cores are present. Bladelets, blades, and flakes are the usual blanks for retouched artifacts. Plain and punctiform platforms are the most common. End- and side-scrapers, backed blades, and notches are the most frequent tool types (Fig. 5.5). No burins were found in the assemblage.

Kızılin (Kayan et al. 1987). This cave is located south of Karain, at an altitude of 410 m. Some soundings (not published) were carried out by Kökten and the material described here comes from what remained on the surface and what was collected from the back dirt of the previous excavation. There were a total of 871 flint artifacts recovered. Blades and flakes are abundant (309); the most usual tool types are notches, slightly retouched blades, and end-scrapers. One lame à crète and six lames outrepassées were found.

Ökuzini (Kayan et al. 1987). Located north of Karain, this cave is at an altitude of 350 m; it was also sounded by K. Kökten. There are 712 flints (347 flakes and blades). Bladelets and bladelet cores are well represented and more abundant than in the other sites. Abrupt retouch is frequent; other tool types are notches and denticulates. Platforms are often broken; when not, they are punctiform.

ZAGROS

Pa Sangar (Minzoni-Déroche 1987b). This cave is situated in the Khorramabad Valley, near the already described Kunji and Gar Arjeneh sites. It yielded 1288 flint artifacts. There is a huge amount of cores and core fragments, numbering over 1000, of which 344 were analyzed by the author. Unipolar cores dominate, but some bipolar cores are also present. There is a large disparity between the retouched and unretouched pieces; possibly a great part of the collection was left in Iran. The most frequent types are end-scrapers, burins, notches, and side-scrapers. Blades, flakes and bladelets constitute the debitage (944).

Yafteh (Minzoni-Déroche 1987b). The collection consists of 5377 flints. The industry from this cave in the Khorramabad region is the richest and the most diversified. Unipolar and bipolar cores are present. Blades, bladelets, and flakes (4950) are the common blanks for end-scrapers, burins, notches, backed blades and bladelets (most often with both edges backed), and "inverse" retouched pieces.

MEDITERRANEAN COAST

Kanal (Bostancı 1968). This site is not a cave, as the Turkish name *Kanal mağara* sometimes suggests. Rather, it consists of a cemented, mixed deposit, which derives from water erosion and downslope movement of sediments. The artifacts were collected without stratigraphic context. Of the 1468 artifacts examined, the typological diversity is high; there are small and round end-scrapers, end-scrapers on blades, side-scrapers, burins on blades, borers, and others. Unfortunately, few details about the cores exist, but unipolar and bipolar flint-knapping is indicated by the blades.

Merdivenli (Bostancı 1968). This cave was first named "First Cave," and then the name was changed to "Merdivenli." Layer III was attributed to the Upper Paleolithic. Levels IV and V are Middle Paleolithic (some caution is warranted with regard to the stratigraphy because some rock blocks belonging to the Roman settlement of Seleucia were found in contact with the natural floor of the cave). The techno-typological characteristics of the Upper Paleolithic assemblage (composed of sixty-eight flint artifacts) are similar to those of Kanal.

Uçağızlı (Minzoni-Déroche 1992). This cave was discovered recently and the material described here comes from the cemented floor on the surface, which covers the in situ layers below it. There are 1667 flint artifacts, which show close affinities with the Upper Paleolithic facies of the Levant, as at Antelias IV (Copeland and Hours 1971), for example. Thin flakes are present, as well as blades and bladelets, both retouched and unretouched. Unipolar and bipolar cores are present; end-scrapers, borers, burins, and backed blades and bladelets form the tool assemblage (Fig. 5.6).

All of these caves are located on the Mediterranean coast of Hatay, between 18 m and 20 m above the present sea level (the Taurus caves are between 350 m and 450 m). Flint sources are found nearby. Pebbles are deposited on ancient Pliocene marine sediments located immediately to the east; the caves themselves were formed in the calcareous Eocene formations.

DISCUSSION

It seems that the data available for the Upper Paleolithic are even more disparate than those for the Middle Paleolithic, making it difficult to suggest, as I do for the Middle Paleolithic, the existence of two different groups: Zagros-Taurus and Levantine coast. Blades and bladelets become common in the Taurus-Zagros as well as on the coast. New and more diversified types appear in both areas. Aspects that seem to differ greatly between the mountains and the coast are the length to width and width to thickness ratios for the flakes and blades. These ratios are definitely longer and thinner on the Mediterranean coast than in the Taurus or Zagros assemblages (see Tables 5.2a and 5.2b).

The following discussion takes into account, for the Middle and for the Upper Paleolithic, three different groupings. These are based on the similarities and differences among the Taurus sites (especially in relation to the Mediterranean coast sites), the similarities and differences among the Zagros sites, and, finally, the features of both complexes together.

The Taurus Middle Paleolithic sites are all situated at altitudes between 440 m and 1250 m, in piedmont regions with small plateaus cut by narrow

valleys. They are surrounded by abundant soft-water springs originating in the powerful karstic systems of these calcareous regions. The settlements are found in caves as well as in open air sites, generally located very close to the primary raw material sources (flint or radiolarite in all the cases). The flint-knapping activities seem to have been carried out on the sites themselves rather than at independent, nearby chipping stations. Flint sources are of two kinds: stratified nodules within the calcareous beds and/or big flint boulders and small river pebbles collected in the riverbeds. In both cases, the flint has been used extensively and the cores are reduced to their last limits. These kinds of exhaustion cores, as well as the quite short dimensions of the blanks, are not apparently influenced by the size/shape of the raw materials, but seem to be a deliberate reduction strategy.

In the different regions where the Taurus sites are located, no evidence of the Lower Paleolithic has been found, and thus no hypothesis of any local evolution of the Lower Paleolithic industries can be suggested (but see Yalçınkaya et al., this volume). It is possible that these Middle Paleolithic industries represent the first human evidence in regions like the western part of the Taurus or the plateaus of the Cilician gates.

As previously mentioned, the cores appear to be completely reduced. Flakes are more abundant than blades and they are usually thick and short and exhibit plain platforms (see Table 5.1b). Some Levallois flakes are present, as well as a few Levallois cores. This indicates that Levallois technique was known but that its use was very limited. In general, the types are not very diverse, and no use-wear analysis has been undertaken.

For the Zagros, the evidence is also quite limited. All the collections come from caves situated at altitudes between 700 m and 1200 m, and the geographical context seems to be similar to the Taurus, particularly for the kinds of flint sources available. No specialization areas have been found in the vicinities of the caves. Exhausted cores are abundant, as are flakes, which are the most common blank. These flakes are quite thick and the tools are not very diverse. When the Levallois technique is present, it is in a very limited way; sites like Shanidar (Solecki 1955) and Bisitun (Dibble 1984; Skinner 1965) seem to share these characteristics.

It appears that some similarities exist between the Zagros and the Taurus sites. Of course, internal differences do exist among the Taurus assemblages, as well as among the Zagros collections; if *all* the characteristics were to be taken into account, each site would be unique and comparisons difficult to accomplish. Despite the local differences, the similarities of the Zagros and the Taurus regions become more striking when compared to the sites located on the Mediterranean coast. For example, the sites of Tikalı and Merdivenli, two nearby caves situated in a very different ecological situation from the Taurus sites, have blank characteristics that are different from those of the Taurus (see Table 5.2a). They are longer and thinner, and the Levallois technique was apparently used to a greater extent.

At present, we lack information about environmental changes between the Middle and the Upper Paleolithic for the regions discussed here. Links between the different Upper Paleolithic sites are more difficult to establish than is the case for the Middle Paleolithic. Furthermore, it seems that during the Upper Paleolithic the industries, as well as the technologies involving raw material use, were changing more rapidly than during the Middle Paleolithic. Moreover, at none of the Turkish sites, neither in the Taurus nor on the coast, is there a stratigraphic link between the Middle and the Upper Paleolithic.

Regional differences are also present in the Zagros; for example, Yafteh's material is much richer and more diversified than that of Pa Sangar. In both cases, pyramidal cores are the most abundant, but an evolution of the blanks can be seen at Yafteh, as well as a blank selection for different types of tools. A major difference between the Zagros and the Taurus Upper Paleolithic is the almost total lack of burins in the Taurus (which is not the case for the Turkish coastal sites where burins are well represented).

The nature of the regional variability appears different in the Middle and Upper Paleolithic. In the former, the similarities between the regions outweigh the differences, and in the Upper Paleolithic, it is the opposite: the differences are more noticeable than the similarities. This raises certain questions. Were the Upper Paleolithic peoples interacting within more localized regions than those of the Middle Paleolithic? Or could it be that there is less chronological overlap among the the Upper Paleolithic sites than is the case among the sites of the Middle Paleolithic? Do changes during the Upper Paleolithic occur so rapidly compared to the Middle Paleolithic that Upper

Paleolithic sites must be absolutely contemporaneous before they can be compared? Might this also indicate that the features that signal the beginning and the end of the Middle Paleolithic are less determinant than those that separate the early part of the Upper Paleolithic from its end?

It is to be hoped that future research will focus on these barely explored regions and their paleoenvironments, and that different stratigraphical contexts will be refined so that we can obtain more information concerning the paleoethnological evidence.

NOTES

1. Out of a total number of 96 flints, there were 8 cores, 4 fragments, and 84 flakes and blades.

2. Out of a total number of 1766 flints, 22 are cores and 1744 are blades and flakes. See also Minzoni-Déroche 1988.

3. Out of 308 flints, there were 71 cores, 25 fragments, 26 waste fragments, and 186 flakes and blades.

4. Out of 401 flints, there were 3 cores, 1 fragment, 59 waste fragments, and 338 flakes and blades.

5. The total number of analyzed flints was 171: 9 cores, 30 waste fragments, 132 blades and flakes, and 4 retouched pebbles.

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TABLES 5.1a and 5.1b. Significant Artifacts from Middle Paleolithic Assemblages.

Table 5.1a:	TAURUS			ZAGROS				
	1	2	3	4	4A	5	6	7
Discoidal cores	8	18	22	3	1	9	27	25
Levallois cores	-	4	5	-	-	-	-	13
Mousterian cores	-	-	5	-	-	-	-	-
Flakes	79	1046	186	284	213	117	499	471
Blades	5	698	-	31	55	15	72	253
Table 5.1b (in percentages):								
Plain platforms	38	39	46	48	*	45	*	*
Faceted platforms	17	32	10	20	51	21	42	52
Others	45	28	44	32	*	34	*	*

(1) Çakmaktepe; (2) Karain; (3) Kocapınar; (4) Kunji (after F. Hole's collection); (4a) Kunji (J. Skinner's collection); (5) Gar Arjeneh; (6) Shanidar (Solecki 1955; see also Akazawa 1975); (7) Bisitun (J. Skinner's study; in H. Dibble's 1984 analysis, these data are not explicitly available for comparison).
* Data not available in respective publications.

TABLE 5.2a. Middle Paleolithic: the Assemblages.

SITE:	Total of Flakes and Blades	Length / Width	Width/Thickness
TAURUS			
Karain	1744	1.5	3.2
Kocapınar	186	1.2	3.0
Çakmaktepe	84	1.3	3.4
ZAGROS			
Kunji	338	1.6	2.9
Gar Arjeneh	132	1.5	3.1
MEDITERRANEAN COAST			
Tikalı*	599	2.3	4.0
Merdivenli**	177	2.1	3.9

*After M. Senyürek 1959.
**After E. Bostancı 1968.

TABLE 5.2b. Upper Paleolithic: the Assemblages.

		Flakes		Blades	
SITE:	Total of Flakes and Blades	Length/ Width	Width/ Thickness	Length/ Width	Width/ Thickness
TAURUS					
Karain	375	1.8	3.2	1.9	2.9
Oküzini	347	1.5	3.1	1.8	2.7
Kızılin	309	1.7	3.2	1.6	2.6
ZAGROS					
Pa Sangar	944	1.2	2.9	2.9	2.8
Yafteh	4950	2.0	3.0	2.3	3.2
MEDITERRANEAN COAST					
Kanal	1468	2.5	4.3	2.7	3.8
Merdivenli	68	2.1	3.9	3.0	4.2
Üçağızlı	1667	2.2	4.5	2.9	3.6

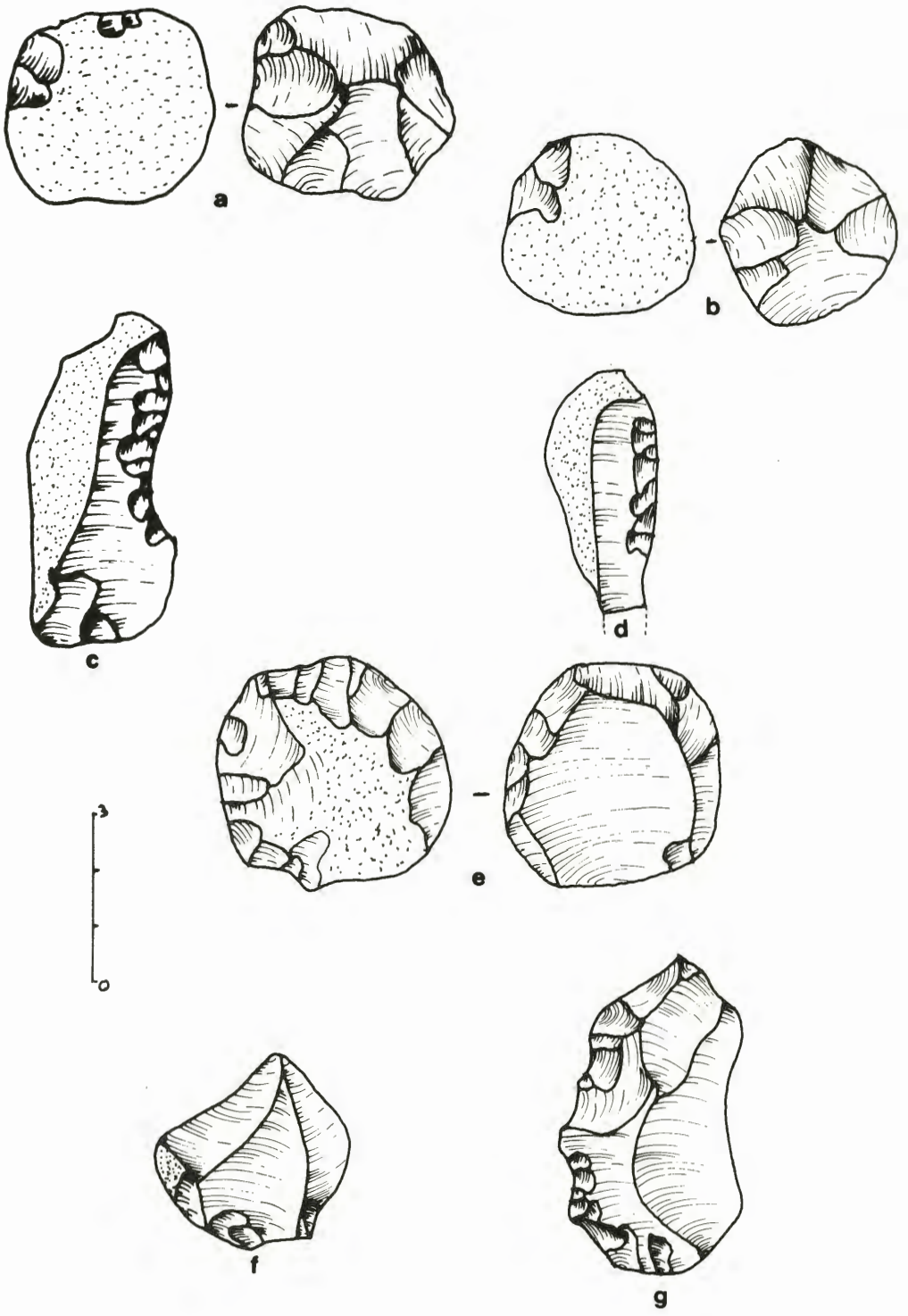

Figure 5.1. *Middle Paleolithic artifacts from Kocapınar: a, c, e, f-g; Gar Arjeneh: b; and Kunji: d.*

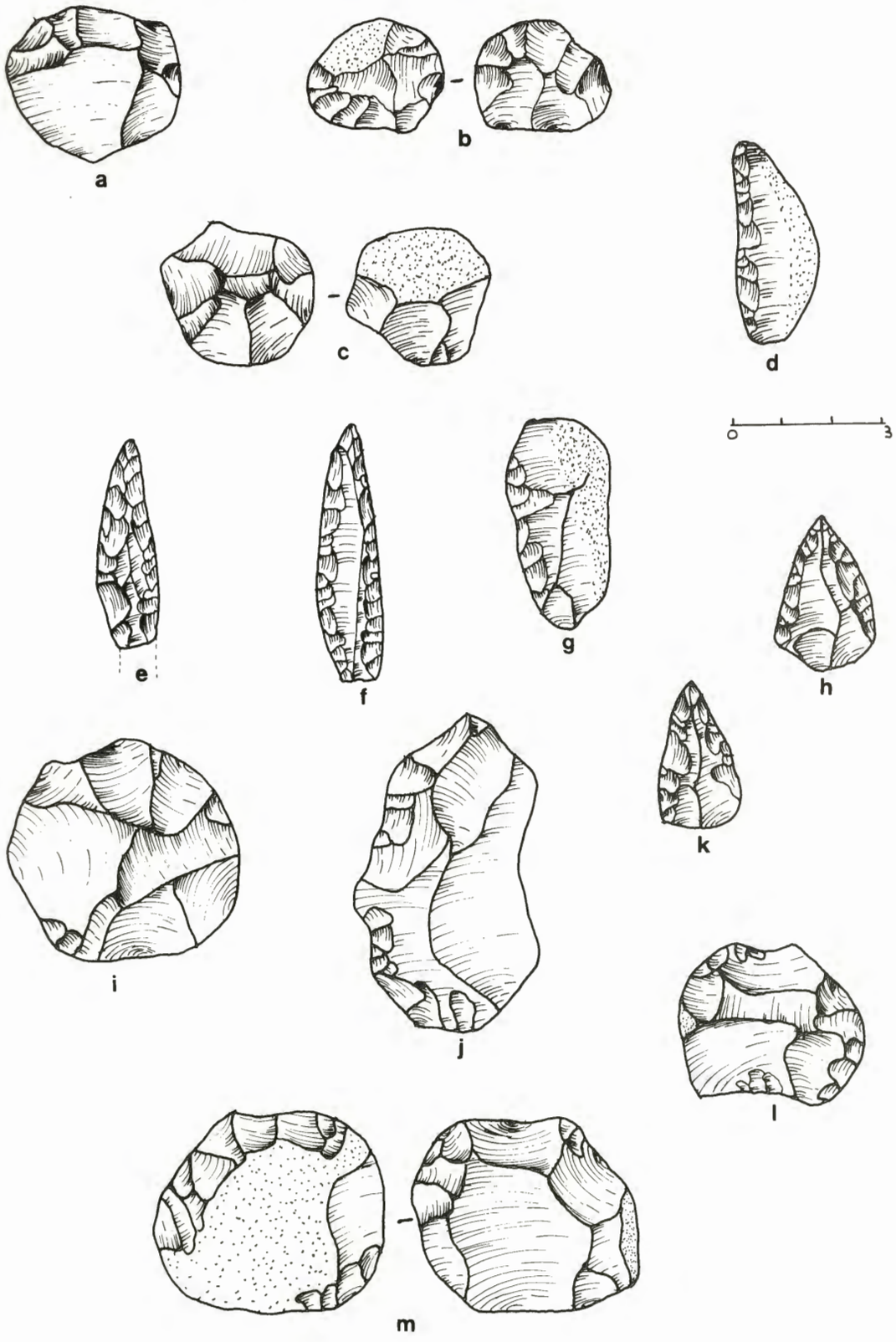

Figure 5.2. Middle Paleolithic artifacts from Karain: a-b, g-h; Kunji: f; and Çakmaktepe: i.

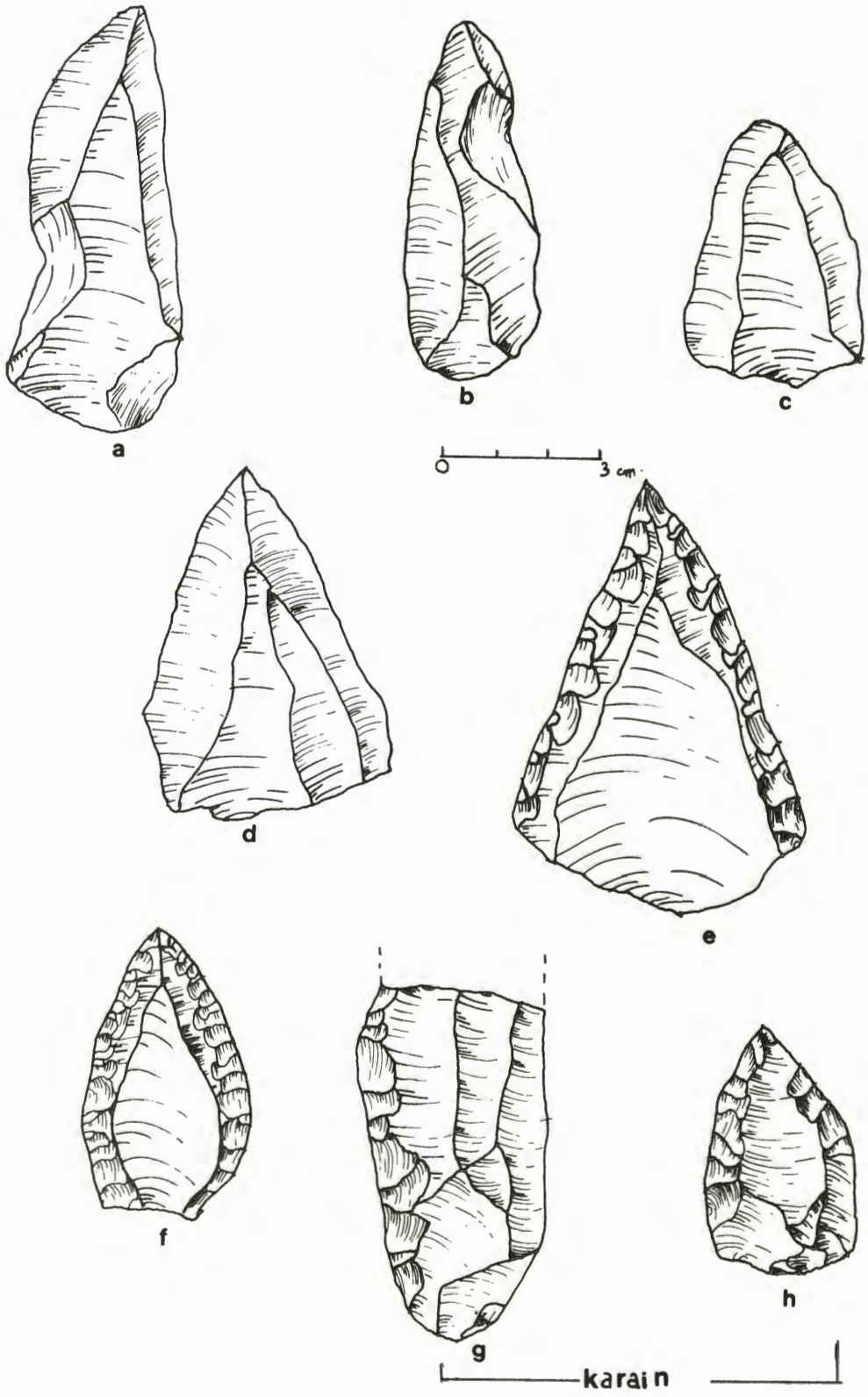

Figure 5.3. Middle Paleolithic artifacts from Tikalı: a-f; and Karain: g-h.

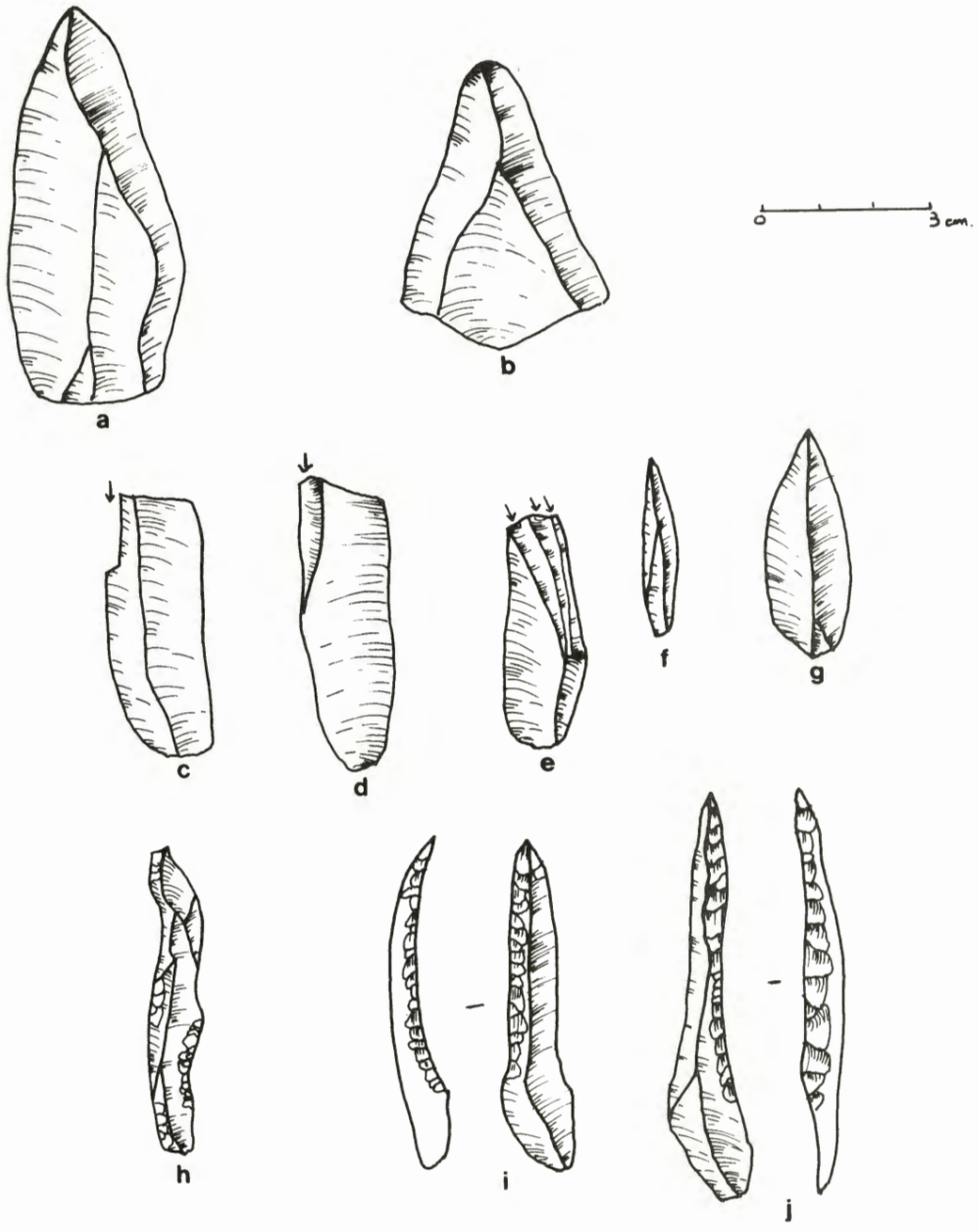

Figure 5.4. *Middle Paleolithic from Merdivenli: a-b.*
Upper Paleolithic artifacts from Kanal: c-g; and Karain: h-j.

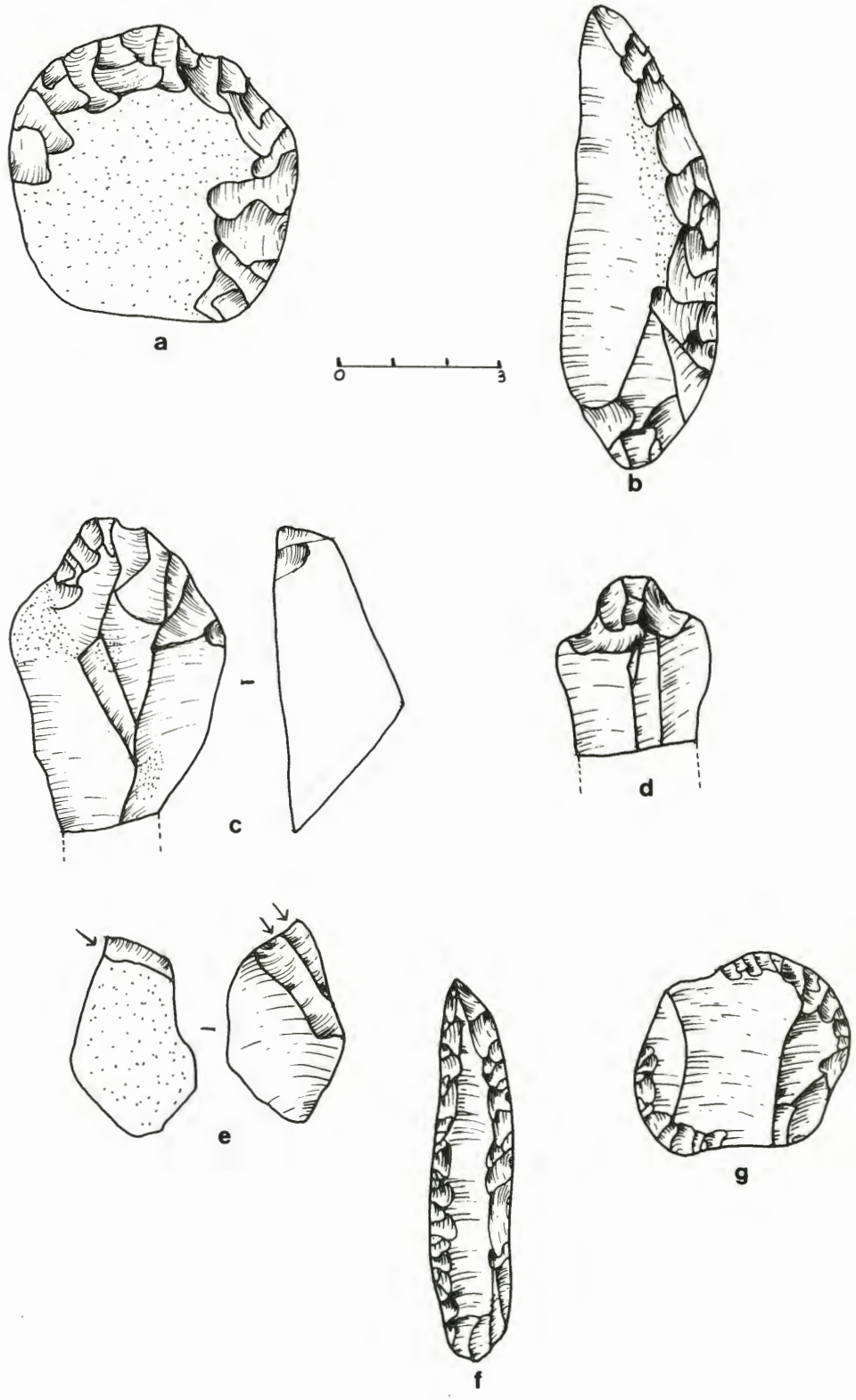

Figure 5.5. Upper Paleolithic artifacts from Üçagızlı.

6

Paleolithic and Epipaleolithic Sites in the Hulailan Valley, Northern Luristan

Peder Mortensen

GEOGRAPHICAL SUMMARY

In the Zagros Mountains, just south of the Kermanshah plain, the Saimarreh River begins at the junction of two principal streams, the Qara Su, which comes from Kermanshah, and the Gamas-i Ab, which drains the Nihavand plain. Proceeding south and west, the Saimarreh River cuts through four major mountain ranges, and about 80 km southeast of Shahabad, it enters the Hulailan Valley through a narrow, steep-sided gorge along the southern slopes of Kuran Buzan (Fig. 6.1). The Jazman Rud, a major tributary, enters the Saimarreh River in the Hulailan Valley. The Saimarreh River continues at right angles through a major syncline, leaving the plain at Tang-i Sarneh on its way toward the southeast through Luristan (Fig. 6.2).

The Hulailan plain lies roughly 930 m above sea level.[1] It is about 25 km long in the direction East-West, and about 14 km wide. It can aptly be divided into three types of landscape: a wide riverbed, partly covered by a poor vegetation of scrub, and flanked on both sides by steep gravel terraces abandoned by a former stage of the river; an extensive, fertile alluvial plain covering approximately 13,000 hectares; and a rolling area composed of rocky, heavily eroded hills bordering the plain (Edelberg 1967:375-376). On either side of the valley are high, folded mountains of Asmari limestone formed during the Miocene and Pliocene periods (Oberlander 1968:195ff.; Mortensen 1974a: Figs. 6.3-6.4). Toward the west the mountains reach a height of 1812 m (Kuh-i Sefid); at the eastern end, Kuran Buzan rises 1543 m above sea level.

The plain was originally formed by alternating episodes of uplift and stability. During periods of uplift, the Saimarreh and its tributaries enlarged the plain by cutting away large areas of soft Cretaceous and Eocene sediments (*flysch*) from the mountains. In stable periods these same streams brought gravels and clay down to the valley and eventually covered parts of it with a layer of alluvium (see Harrison 1946:55ff.). In the large plains of Khorramabad, Mahidasht, and Kermanshah, serious erosional destruction of the Zagros Mountains, followed by a massive alluvial deposition of sediments, took place as late as the Early Medieval periods (Vita-Finzi 1969:960ff.; Butzer 1972:309; Brookes et al. 1982:284ff.; see also Brookes 1982). In the Hulailan Valley, however, the formation of the alluvial plain was probably largely completed by the end of the Pleistocene period. Ravines, especially into the right bank of the Saimarreh, were later cut into the alluvial deposits by a number of streams carrying water from the mountains. Some of these streams may have been the result of melting glaciers by the end of the Pleistocene period (Wright 1962:134ff.). It is notable that most of the torrent beds are now completely dry, a circumstance often associated with changes in historical times, caused by severe earthquakes that have changed the subsoil drainage systems and closed some of the rich springs in the mountains. Some support for this viewpoint may be found in the tectonic movements mentioned by Bobek, Voûte, and Wedman, and in local information, quoted by Sir Aurel Stein, on the effects of a severe earthquake in the Kuh-i Dasht in 1924 (Bobek 1963:411-412; Voûte and Wedman 1963:395ff.; Stein 1940:265).

Today, the eastern part of the valley, consisting mostly of undulating gravel hills and terraces, is not very suitable for cultivation. The best agricultural land in Hulailan is the central and western part of the plain, north of the Saimarreh. Here the groundwater level is high, and water can easily be drawn by channels from the Jazman Rud and the Sul-Ab-Warbar. In addition to this, the groundwater of higher areas, especially from the hills and mountains north and west of Kahreh, was previously brought out to the surface in lower parts of the valley by a series of wells connected by subterranean aquaducts. This system of *qanats* seems to go back to the Sassanian or even the Parthian period, but it was almost completely destroyed by the Mongols during their campaigns through this part of Luristan in the late fourteenth century A.D. (Mortensen and Mortensen 1989:929-931). Early in this century, however, two of the old *qanat* systems were partially cleaned up in order to bring some water from the mountain springs to Kahreh and to the fields west of the Jazman Rud (personal communication from the late Khan Abdul-Hussain Pur Abukhadoreh, 1973). In such areas on the alluvial plain where irrigation is applied, it is now possible to harvest twice a year.

THE HULAILAN SURVEY: AIMS AND METHODS

The discovery and first publication of the so-called Luristan bronzes in the late 1920s attracted several travelers and archaeologists to Luristan. In 1936, Sir Aurel Stein explored the valleys along the Karkheh and the Saimarreh rivers searching for remains of ancient buildings, settlements, and graves with Luristan bronzes. On April 7, he arrived on horseback, the first archaeologist in the Hulailan Valley. During the following week he found seven sites, three of which he tested by minor excavations (Stein 1940:240ff.). After Sir Aurel Stein's journey, almost thirty years passed without any archaeological investigations in this part of Luristan. But in 1962-1964 an expedition from the Danish National Museum, in cooperation with the Archaeological Service of Iran, conducted a survey in the valleys of Shabedagh, Hulailan, Bouluran, Tarhan, and Kuh-i Dasht. The main purposes of this survey were to find Bronze or Early Iron Age sites that might elucidate the chronology and cultural background of the Luristan bronzes, and to find a Neolithic mound with good potential for excavation. In 1963-1964, a few sites were tested by soundings and minor excavations, including Tepe Guran in the Hulailan Valley (Meldgaard et al. 1963:97ff.; Thrane 1964:153ff.).

Between 1963 and 1967, the valley was visited several times by Clare Goff, whose work in central and northern Luristan has contributed enormously to our knowledge of Chalcolithic, Bronze Age, and Early Iron Age settlements in Pish-i Kuh. In Hulailan, she came upon three previously unnoticed mounds on the alluvial plain and a cave with thick deposits of Late Chalcolithic and Parthian remains (Goff 1968:126-132; 1971:134ff.).

After these investigations, it was thought that Hulailan had been relatively well covered in terms of archaeological exploration. Seventeen sites had been found north of the Saimarreh River, including two caves with Neolithic remains; Tepe Guran with a unique sequence of Neolithic occupations covering more than a thousand years, from the early seventh toward the middle of the sixth millennium B.C.; a few Chalcolithic mounds; and a number of Bronze and Iron Age settlements and cemeteries.

While working on the publication of the material from Tepe Guran, however, I realized that our knowledge of the distribution of early settlements was extremely poor. There was no evidence from Luristan of the interaction between permanent villages and seasonal camps or specialized activity sites from the crucial period between 11,000 and 5500 B.C. Furthermore, no Neolithic site contemporary with Tepe Guran had been found. This might indicate either a widely spread pattern of Neolithic settlements or—more likely—reflect the fact that none of the three previous surveys, carried out on horseback or by Land Rovers, had been designed to discover sites that were so small they would easily be missed, unless one happened to walk across them (see Mortensen 1979:8, note 5).

Stimulated by this uncertainty, I decided in 1973 to resume our work in Hulailan in order to provide a data base which could be used for studies of the relationship between villages and seasonal camp sites, and as a basis for more detailed studies of the economic, social, and structural changes that preceded and accompanied the origin and early

development of agriculture and specialized village-communities in the Zagros. It was thus necessary to plan a survey during which not only villages, cemeteries, caves, and shelters would be found, but also minor settlements and camp sites, only visible on the surface as restricted areas with a concentration of chronologically related artifacts. In order to obtain an additional impression of man's changing activities (hunting, flint-knapping, etc.) in the various types of landscape, we decided to pay special attention to the spread of single finds and to be aware of the distribution of important raw materials such as flint, clay, chalk-spar, alabaster, and marble.

Although originally planned as a total survey of the plain, it soon became clear that time would allow only for an investigation of the northern part of the valley, including a section of the surrounding mountains, the foothills, and the alluvial valley floor, and, limited toward the south by the Saimarreh River. The survey was carried out by dividing the area into square kilometers, each of which was searched on foot by a line of four to five people, averaging 20 m between each surveyer. During two seasons of fieldwork, in 1973 and 1974, the number of known archaeological sites within an area of 146 km^2 north of the Saimarreh River was increased by 144 to a total number of 161 sites. Twenty-four of those—and a large number of single finds—were classified as Paleolithic and Epipaleolithic; but unfortunately only two of the sites (Mar Ruz and Mar Gurgalan Sarab) could be tested by minor soundings.[2]

In the presentation of the material that follows, I have attempted to divide the material into four chronological groups: Lower Paleolithic, Middle Paleolithic, Upper Paleolithic, and Epipaleolithic. To deal with the Paleolithic and Epipaleolithic materials from the survey, the sites and finds have been assigned to one of three possible categories: *caves and shelters*; *open-air sites*, that is, restricted areas with a concentration of chronologically related or contemporary artifacts found on the surface, without any apparent accumulation of occupational debris underneath; and *single finds*, which in this context comprise single occurrences of chronologically diagnostic artifacts, such as Mousterian points, Levallois flake cores, or Zarzian "thumbnail" scrapers.

The sites are here numbered 1-24 with the original field registration numbers assigned to the sites during the survey quoted in brackets after the name of the site. The material found in 1973 and 1974 is kept, under the field registration numbers, in the Muzeh-i Iran-i Bastan in Tehran.

LOWER PALEOLITHIC

Even before we started our survey, it was obvious that any traces of prehistoric settlement in the Hulailan Valley would probably be concentrated on the alluvial plain and in the rocky areas west of Kahreh, where a number of caves and shelters, abundant fresh water, and a fair amount of nodular flint in the hills and along the streams were located. Because we were aiming at a study of prehistoric settlement patterns, our intensive survey was designed not only to show the obvious *presence* of settlement and natural resources in the west, but also to demonstrate the *absence* of prehistoric sites in the eastern part of the valley. With this purpose clearly established, we spent most of September and early October 1974 tediously walking up and down the desolate gravel hills northeast of Chasmeh Mahi, occasionally collecting a few Parthian or Sassanian sherds or studying the remains of an early twentieth-century water mill near the river. It was therefore a great surprise when, on October 7, one of our Iranian students, Aghil Abbedi, picked up a small ovoid hand ax in the hills just north of the village of Sar Cam (Figs. 6.3-6.4). A few days later this interesting single find was followed by the discovery of a site with artifacts from the same period, a little more than 1 km northeast of Sar Cam.

1. *Pal Barik* (reg. no. H 158). This site is situated south of the mountains bordering the valley, on a flat hilltop with a fine view over the Saimarreh River. Eighty-nine flint artifacts, all heavily patinated, were found. They were collected from the surface within an area of approximately 50 x 80 m. Because the hill had been ploughed several times during recent years, the artifacts may originally have been concentrated within a smaller area. The collection from Pal Barik can roughly be described as follows:

1 small subtriangular hand ax (Fig. 6.5a).
31 choppers. On most of the chopping-tools cortex is partially preserved, and the preparation ranges from cores with only two or three flakes taken off one edge to pieces displaying flake-scars over most of one face and with bifacial flaking along the

chopping edge (Figs. 6.5b-d and 6.6a-c and e).

1 large point made from a core by coarse, bifacial flaking with cortex preserved at the proximal end (Fig. 6.6d).

2 disc-shaped cores with cortex partially preserved on one face (Fig. 6.7m).

8 amorphous cores and core fragments (Fig. 6.7b).

3 end-scrapers made on flakes (Fig. 6.7i).

2 side-scrapers, both made on primary flakes with cortex preserved on one face (Fig. 6.7f).

6 points made on flakes modified by irregular flaking or retouch (Fig. 6.7a and c-e).

8 notched or denticulated flakes (Fig. 6.7k-l).

25 flakes with irregular retouch along the edges (Fig. 6.7g-h, j, and n).

2 flakes without retouch.

Almost half of the artifacts (42 pieces) are made on cores, and many of the flake tools are made on thick natural or accidental flakes (e.g., Figs. 6.5c and 6.7a). Like the choppers, some of the flake tools are bifacially flaked along the edge. Most of the cores and many of the flakes retain part of cortex on one face or end. It is characteristic for the assemblage that the tools are all rather small. The largest piece of flint is the hand ax, which is 10.4 cm long; the choppers range from 9.5 to 4.9 cm in size; and the length of the flakes and flake tools range from 8.6 to 2.6 cm, with an average of 5.6 cm. The artifacts from Pal Barik were all made of flint, the patinated color of which varies from creamish yellow to reddish brown.

In an attempt to date the assemblage from Pal Barik, the geomorphological study of the Hulailan survey area by Ian A. Brookes is important.[3] I quote from his report:

> Piedmont geomorphic elements are the most extensive in the study area. They include gravel-veneered pediments and alluvial gravel fans which extend from the base of limestone escarpments and hogback ridges to the narrow alluvial valleys of the Saimarreh River and its right bank tributary, Jazman Rud. . . . Two such pediments are seen in the study area, best developed north of the Saimarreh. The higher and, thus, the older one has been extensively dissected by later erosion and remains only on interfluves, usually closer to the mountain front. . . . The lower and younger pediment is extensively developed both north and south of the Saimarreh. It was fashioned by streams which reduced the higher pediment to its present interfluve remnants, occupying narrow valleys between these, but broadening distally into continuous, gently-sloping surfaces. . . . Mortensen's 'Acheulean' artefacts found near Sar Cam lie on the surface of the lower of the two pediments. . . . The two pediments are the oldest non-bedrock geomorphic elements present and both probably predate the Last Interglacial (> 130 ka before present).

Although the artifacts were probably found in situ (perhaps slightly disturbed in recent time by ploughing), the geomorphological setting of the site only gives a *terminus post quem*, indicating that the site of Pal Barik is younger than 130,000 years b.p.

Typologically, there is no unambiguous indication of its age. Just after its discovery, the occurrence of points and small hand axes led to the suggestion that it might represent a Mousterian of Acheulean tradition (François Bordes and Jean Perrot, personal communication). However, there is not much evidence in support of this idea. The Mousterian of Acheulean tradition is usually defined as an early facet of the European and east Mediterranean Middle Paleolithic tradition. Its most eastern local variety, as defined by Bordes, has possibly been found at shelter 1, layer 12 at Yabroud in Syria (Bordes 1968:126), but the composition of this assemblage has no similarity to Pal Barik (see Rust 1950:37-38 and Pls. 41-42). Although choppers sometimes occur at Mousterian sites in the Zagros, an earlier date is suggested by the heavy patination of the individual pieces, and in particular by the absence of any diagnostic Mousterian features, including the prepared-platform and Levallois techniques, which otherwise in the Near East can be traced back at least into the Last Interglacial period (see Copeland 1983:15; Dibble 1985:391).

In the Zagros, single, isolated "Acheulean" hand axes had previously been picked up on an open hilltop near Kermanshah (Braidwood 1960:695, Fig. 1) and at a massive gravel deposit at Eski Kelik on the right bank of the Greater Zab (Braidwood and Howe 1960:62). The most likely

parallel to Pal Barik seems, however, to be the two "Late Acheulean" sites found by Bruce Howe and H. E. Wright, Jr., at Barda Balka and Cam Bazar in Iraqi Kurdistan (Braidwood and Howe 1960:31, 61-62, 150-152, and Pl. 26). The excavation at Barda Balka revealed an industry with a few hand axes (less than 5% of the tools) and a great number of roughly flaked pebble tools and flakes, including many points and a few technically poor scrapers. The surface collection from Cam Bazar is similar. As at Pal Barik, the artifacts from Barda Balka and Cam Bazar are all remarkably small compared to the classical Acheulean industries in Europe and the Levant.

Typologically, this peculiar Zagros Acheulean industry, as represented at Barda Balka, Cam Bazar, and Pal Barik, is difficult to characterize because none of its few hand axes are very similar to one another, the choppers are simple and exhibit a wide range of different morphological features, the flakes are roughly made, the points are not in any way distinctive, and the scrapers are poor.

This is the main reason why—seen in a wider perspective—the Zagros Acheulean tradition cannot yet be linked to any of the late Lower Paleolithic or early Middle Paleolithic cultures of the Levant, or Central or Southeastern Asia. I have previously suggested that the Zagros Mountains might represent an area where the Acheulean hand ax tradition and the chopper/chopping tool tradition of the Pakistani Soan industry overlap (Mortensen 1975:2). In that case one might ask how such a mixture took place, what it represented, and why the resulting technology and morphology are so indistinctive. Thus, until more substantial evidence is available, "the real nature of the Lower Palaeolithic of Iran eludes us" (Smith 1986:17).

Geologically, the Barda Balka assemblage has been placed within the Riss-Würm Interglacial or, less likely, at the very start of the Last Glacial period. Based on the typological parallels with Barda Balka and the geomorphological evidence from Hulailan, a similar date might be suggested for Pal Barik, that is, an age tentatively estimated at 100,000–80,000 years b.p.

MIDDLE PALEOLITHIC

During the Hulailan survey, small concentrations of Mousterian artifacts were discovered at three shelters and five open-air sites:

2. *Ghar Huchi* (reg. no. H 54). A small shelter, 6 x 2 x 1 m,[4] in a cliff on the right bank of the Saimarreh, about 15 m above the riverbed (Mortensen 1974a: Fig. 7). The deposits in front of the shelter, facing south, seem to cover an area of 5 x 10 m. One large discoidal flake core, 2 Levallois cores, 1 fragmentary flake core, 1 side-scraper, 3 end-scrapers, and 5 retouched, and 1 notched flake were picked up from the surface. The flake cores, the size of the flakes and scrapers (varying between 6.8 and 10.4 cm), the glossy, brown patina of the flint, and the fact that two of the flakes were struck on a prepared platform, clearly indicate that the shelter was used in the Middle Paleolithic period.

At Sar Khalija, on the alluvial plain ca. 1 km north of Ghar Huchi, a single, isolated Mousterian point made on a Levallois flake was found (Fig. 6.10d).

3. *Ghar Villa* (reg. no. H 83). One of several shelters, 8 x 2 x 2 m, along the eastern side of Kuh-i Sefid (Mortensen 1974a:8, Fig. 6). From the shelter there is a fine view toward the southeast over Villa, a small triangular valley, the floor of which is composed of rolling gravel hills. At the eastern point of the triangle, the valley is connected with the Hulailan plain by Tang-i Mikush, a narrow gorge, approximately 2 km long. The area is now dry, but the remains of a qanat leading from Ghar Villa, through Tang-i Mikush, into the plain suggests more humid conditions in the past. This impression was confirmed by Assad Mansur, an old man from the village of Kahreh. When he was young, he told me, he had often rested at Ghar Villa, waiting for ibex and gazelle that came in the early morning to drink from a stream that is now permanently dried up.

Although the sedimentation in front of the shelter is less than half a meter thick, the surface yielded forty flints, suggesting a Middle Paleolithic occupation. The collection includes 2 large discoidal flake cores, 2 fragmentary cores, 1 simple Levallois point (Fig. 6.10f), 2 side-scrapers, 2 denticulated and 3 notched flakes, and 23 retouched and 5 unretouched flakes, ten of which were struck from cores with a prepared platform.

Several—probably redeposited—Mousterian artifacts were picked up on the surface of the *terra rossa* formations in the small valley in front of Ghar Villa and along the sides of Tang-i Mikush: 2 Mousterian points (Fig. 6.10a), 2 discoidal cores and 1 Levallois core (Mortensen 1975a: Fig. 11a-b), several notched flakes (Fig. 6.10b), and a few flakes

made from cores with a prepared platform.

4. *Ghar Sefid* (reg. no. H 95). A small shelter, 6 x 2 x 3 m, at the western end of the valley, facing south with a view toward Sar Sarab. The shelter is situated about 30 m above the valley floor. Thirty-eight pieces of flint were collected on the slope in front of the shelter: 3 large flake cores, one of them with a prepared striking platform, 4 fragmentary cores, 2 side-scrapers, 2 burins made on flakes, 1 burin secondarily made on a Mousterian point (Fig. 6.10g), 13 retouched flakes, 8 flakes without retouch, and 5 blades. More than half of the flakes and blades are rather small (< 4 cm) and undiagnostic. They may represent a later element of the assemblage mixed with Middle Paleolithic artifacts.

5. *Chesmeh Kahreh* (reg. no. H 29). An open-air site on the plain between two rocky hills 100 m south of a well called Chesmeh Kahreh (Mortensen 1974a: Fig. 16). From the well, a brook leads toward the south, passing on its left side the remains of a small Sassanian or Early Islamic village. Traces of a boulder-built wall show that the stream was originally diked in connection with the settlement. Today a shallow pool of water still remains at this point. Along the western bank of the pool, and partly under water, were found 55 pieces of flint, heavily worn by water and with a glossy brown or grayish brown patina. The collection included 4 large flake cores, 4 Mousterian points (Fig. 6.8a-c), 4 scrapers (Fig. 6.8e), 1 borer (Fig. 6.8f), 12 retouched and 23 notched flakes (Fig. 6.8d and g), and 7 unretouched flakes, indicating a Middle Paleolithic date for the site.

6. *Sar Sarab A* (reg. no. H 94). An open-air site on a headland of exposed bedrock, protuding a few meters from the left bank of the Rud Kahreh, just below the rocky hills of Sar Sarab. Near the southern point of the headland, 19 pieces of flint with a glossy, brown patina were found. The collection comprises 1 small flake core (Fig. 6.9a) and 2 core fragments, 3 choppers (Fig. 6.9c), 2 retouched and 3 notched flakes (Fig. 6.9b), 3 backed knives (Fig. 6.9f), 4 scrapers (Fig. 6.9e), and 1 Levallois point (Fig. 6.9d), suggesting a Middle Paleolithic date.

In the hills of Garacherach, about 1.5 km east of Chesmeh Kahreh, and in the area between Chesmeh Kahreh and Sar Sarab A were found a few, isolated Mousterian artifacts (Fig. 6.10c, e, and h).

7. *No local name* (reg. no. H 101). On a natural hilltop a little less than 1 km east of the Jazman Rud. The concentration of flint artifacts with a glossy, brown patina includes 11 flake cores and core fragments, including 2 fine Levallois cores, 1 end-scraper, 1 burin made on a flake, 5 notched flakes, 1 Mousterian point, 1 unfinished (?) Mousterian point, and 5 flakes without retouch.

8. *Saimarreh E* (reg. no. H 136). On top of a natural hill, ca. 1 km north of the Saimarreh, a small concentration of 29 flint artifacts with a glossy, brown patina was found. These include 7 flake cores, 1 end-scraper, 1 side-scraper, and 20 retouched flakes, including seven pieces struck from cores with a prepared platform.

9. *Saimarreh F* (reg. no. H 138). On a hilltop north of the river and ca. 1 km east of Saimarreh E, a concentration of flint artifacts with a glossy, brown patina was found. Eight flake cores, including 3 Levallois cores, 5 core fragments, 1 backed knife made on a core, 2 side-scrapers, 1 borer, 1 notched flake, 2 points (one of them possibly a fragment of a large Mousterian point), and 13 retouched and 22 unretouched flakes, half of which were struck from cores with a prepared platform, comprise this collection. The flints were found beside a large stone on the flat surface of which seven holes, connected by grooves, were carved. A rimsherd of a Parthian jar, found near the stone—among the Mousterian artifacts—might suggest that the carving is late.

The concentrations of Mousterian artifacts discovered during the survey (Fig. 6.11) were found near the rivers or in the western part of the valley in a rocky area with caves and shelters, a great quantity of flint nodules, and an abundance of springs and streams that would be attractive to animals as well as hunters. Flake cores and debitage found at all the sites show that flint-knapping was performed in situ, and the occurrence of choppers, scrapers, and Mousterian and Levallois points strongly suggests hunting and butchering activities. At Chesmeh Kahreh (site no. 5) a remarkably high number of notched flakes (42%) might indicate the performance of more specialized activities. The Binfords have tentatively suggested a functional interpretation of notched flakes, within a Mousterian context, as "gut-stroppers" (Binford and Binford 1966:244).

None of the sites was large enough to allow for an interpretation as seasonal base camps for a

band of hunters. The floors of the three Mousterian shelters do not exceed 15 m^2, and the open-air sites only cover a few square meters. It seems more likely, therefore, to assume that they were occupied occasionally by small hunting parties analogous to the Mousterian sites north of Kuh-i Dasht, tested and interpreted by C. B. M. McBurney as "specialized summer encampments designed to exploit such animals of the high mountain environment as ibex, wild sheep etc." (McBurney 1970:186).

The Middle Paleolithic artifacts found in the Hulailan Valley are closely related to the so-called Zagros Mousterian assemblages found at Bisitun Cave (Coon 1951), the Houmian shelter north of Kuh-i Dasht (Bewley 1984), and at Kunji Cave and Ghar Arjeneh in the Khorramabad plain (Hole and Flannery 1967; Baumler and Speth, this volume). However, although the Middle Paleolithic in the Zagros may have lasted for more than 50,000 years, no clearly marked typological development has as yet been demonstrated from the earlier to the late Mousterian industries (see Dibble 1984:23ff.). There are differences between some of the Mousterian assemblages found in caves and shelters and some of those from open-air sites. But it is not clear whether these dissimilarities, including the occasional use of prepared-platform and Levallois techniques, reflect chronological differences, the presence of several traditions of ethnic groupings, or functional and seasonal variations in the activities practiced at the various types of sites. Consequently, the distribution map showing Middle Paleolithic sites and single finds in Hulailan is not to be interpreted as simultaneous occupation at the three Mousterian shelters and five open-air sites.

UPPER PALEOLITHIC AND EPIPALEOLITHIC

Unfortunately, it is not possible, on the evidence available from the Hulailan Valley, to relate the Mousterian to an Upper Paleolithic sequence. The Baradostian is possibly present in the Hulailan, but we cannot clearly distinguish Baradostian assemblages in our survey collections. An Upper Paleolithic element was perhaps mixed with the Mousterian artifacts found on the slope in front of the shelter Ghar Sefid (site no. 4); and at Mar Gurgalan Sarab. A small sounding, carried out at the opening of the cave at Mar Gurgalan Sarab, revealed two layers (D-E) that were overlain by two Zarzian deposits (B-C). Layers D-E were probably Baradostian. They produced some rather indistinctive Upper Paleolithic materials, dominated by burins and unretouched blades. Six caves and shelters and nine open-air sites with Epipaleolithic (Zarzian) flints were found during the survey (Fig. 6.12).

10. *Mar Gurgalan Sarab* (reg. no. H 31). A cave, 16 x 6 x 2.5 m, opening toward the southwest (Mortensen 1974a: Fig. 16). In 1973, a few Parthian sherds and 433 flint artifacts were collected from the floor of the cave and from the surface in front of it. The most common types were notched or denticulated blades (58%: Fig. 6.13a and i-j), small end-scrapers (18%: Fig. 6.13f-h), burins (8%: Fig. 6.13k-l), small borers (7%: Fig. 6.13m), and backed bladelets (3%: Fig. 6.13b-d). A 1 x 2 m wide (maximum width at surface level) sounding was made in October 1974 (Fig. 6.14). It revealed seven layers, which can be briefly described as follows:

A1-A2: Grayish brown soil containing a few Parthian and Sassanian sherds.

A3: Yellowish white clay with a great number of more or less adjoining fragments of rock, fallen from the roof of the cave. Two Parthian sherds were found among the stones in the upper part of the layer. The lower part was sterile and seems to have sealed the underlying deposits.

B-C: Grayish brown clayish sand with some limestone fragments. Layer C is looser than B, which to a certain extent is cemented by the high lime content in the soil. A little less than 0.4 m3 was excavated from these two layers, containing 23 bone splinters and 1248 pieces of flint. The flints consist of 2 retouched flakes, 8 retouched blades, 11 notched blades, 3 borers made on blades, 6 small end-scrapers (Fig. 6.15e), 4 burins, 2 single-shouldered points, 3 retouched microblades, 6 backed and truncated microblades (Fig. 6.15a, c-d and g-h), 1 microborer, 1 microburin, 2 lancets, 3 triangles (Fig. 6.15f and i-j), and 3 trapezes (Fig. 6.15b and k-l). Raw material and debitage include 32 flake-, blade-, and microblade, cores, 252 flakes, 99 blades, 164 microblades and 646 small chips of flint. A few particles of charcoal were found in layer C.

D-E: Yellowish brown sand, toward the bottom more clayish (E), and with a large content of lime particles. Approximately 0.4 m3 was excavated from the two layers, revealing 2 fragments of bone and

350 pieces of flint: 2 retouched flakes, 1 notched blade, 1 borer made on a blade, 1 end-scraper made on a blade, 3 burins, 10 retouched microblades, and 1 backed microblade. Raw material and debitage: 10 flake- and blade cores, 112 flakes, 30 blades, 47 microblades, and 132 small chips of flint.

At a depth of 2 m below the surface, bedrock (?) was reached. In contrast to Mar Ruz (site no. 11), layers B-C at Mar Gurgalan Sarab may reflect an actual habitation, stretching from the inside of the cave toward the southwestern slope. The concentration of flint in layers B-C is remarkably high (ca. 3100 pieces per square meter). The dominance of small scrapers and notched blades, and the presence of single-shouldered points and geometric microliths, clearly place both layers in the Epipaleolithic period. In layers D-E the concentration of flint is much lower (ca. 875 pieces per square meter), and the prevalence of burins in connection with the absence of geometric microliths suggests an earlier, possibly Baradostian, date for the two layers.

11. *Mar Ruz* (reg. no. H 22). A small cave, 11 x 6 x 2.5 m, in a rocky hill immediately above the plain (Mortensen 1974a: Figs. 13-14). From the cave there is a good view toward the south over the southwestern part of the Hulailan Valley. According to local information, one or two stone-built graves were found in the cave some years ago. No traces of those were visible, but 5 simple Early Iron Age sherds were collected from the surface, 311 flint artifacts were found in front of the cave, including a large number of notched or denticulated blades (50%: Fig. 6.16b), small end-scrapers (37%: Fig. 6.16f-k), backed bladelets (4%: Fig. 6.16c-e), and burins (4%). The inventory also included 2 single-shouldered points, one of which is shown on Fig. 6.16a. In 1974, a small trench, 1 x 2 m, was opened just outside the cave. It yielded three main layers (Fig. 6.17):

A1: Loose, grayish surface soil.

A2: Grayish soil with a number of coarse-ware sherds (Islamic ?) and a fragment of a bronze needle. Toward the south, an oven (?), the top of which had been cut off.

B: Yellow, sandy clay containing a large number of limestone fragments. From top to bottom the layer was very homogeneous, although the lower part of it was more closely cemented than the upper part. Roughly 0.7 m3 of layer B was excavated, containing 29 tiny bone splinters, 2 shells of Helix salomonica, and 396 pieces of flint: 6 retouched blades, 3 notched blades (Fig. 6.18g-i), 1 flake borer, 5 small scrapers (Fig. 6.18n-o), 2 burins one of which is made on a blade core (Fig. 6.18p), 1 microblade with an oblique truncation (Fig. 6.18j), and 3 backed microblades, one of them with an oblique truncation (Fig. 6.18k-m). Raw material and debitage: 7 flake-, blade, and microblade cores, 84 flakes, 17 blades, 88 microblades (Fig. 6.18a-f), and 179 chips of flint.

The excavation was stopped at a depth of 1.75 m, because most of the trench by this time was occupied by bedrock, so that further digging would have been impossible without widening the trench toward the south. The evidence from the trench, however, is clear. Below two levels of recent occupation (A1-2) is a thick layer (B), the homogeneity of which suggests that it was secondarily deposited on the slope outside the cave. The concentration of Epipaleolithic flints at Mar Ruz is remarkably lower than at Mar Gurgalan Sarab (ca. 565 pieces per square metre).

12. *Ghar-i Gagel* (reg. no. H 24). A shelter, 4 x 3 x 1 m, opening toward the south. The sedimentation in front of the shelter is areally small and less than a meter thick. The three pieces of flint found on the surface (1 small retouched flake, 1 burin made on a truncated blade, and 1 thumbnail scraper) might suggest an Epipaleolithic date for the deposit.

13. *Sal Mar* (reg. no. H 42). A small, very irregular cave, 8 x 4 x 3 m, opening toward the south. The deposits in front of the cave seem to be between 1 and 2 m deep. Parthian and Islamic sherds imply that the cave was used as a shelter in historical times, but three small flint artifacts (1 microblade core, 1 primary core tablet, and 1 burin made on a small end-scraper) indicate the presence of an earlier Epipaleolithic occupation beneath the Parthian remains.

14. *Dar Mar* (reg. no. H 43-44). A large cave facing south and with a fine view over the Hulailan plain. The cave is approximately 25 m wide at the opening and has two galleries, connected by a short passage. The largest gallery is about 15 m deep; the other gallery is 8 m deep from the entrance. Ten meters northeast of these two galleries is a 2-m-wide opening to a third, 12-m-deep, gallery.

Dar Mar was first visited in 1964 by a member of the Danish archaeological expedition who noted that the sedimentation just in front of the

cave was about 30 cm deep, consisting of two black layers, separated by a brown layer (Erik Brinch-Petersen, personal communication). According to local information (Faisala Mansur), the roof of the cave collapsed during an earthquake in the 1950s, leaving part of the cave inaccessible. A spring just below the cave is said to have dried up on this same occasion.

Parthian sherds picked up from the floor near the entrance can perhaps be associated with a local tradition mentioning the presence of stone-built graves in the cave; and three straw-tempered sherds (1 buff and 2 red-slipped) found together with five heavy pebble-choppers imply that the cave was used in Neolithic times (Mortensen 1974a:37). In the cave, and on the surface in front of it, 67 flint artifacts were found. Some of these may be Neolithic, but the collection included 3 microblade cores, 11 notched blades, 4 retouched microblades, 1 single-shouldered point, and 7 thumbnail scrapers, suggesting an Epipaleolithic date for the main occupation of the site.

15. *Ghar Qalajaha* (reg. no. H 79). A shelter, 4 x 2 x 2 m, facing south, and with only a little sedimentation, less than 0.5 m thick, in front of it. On the surface were found four flint artifacts: 1 blade core, 1 small borer made on a blade, 1 denticulated blade, and 1 thumbnail scraper.

16. *Warbar* (reg. no. H 71). An open-air site on a small natural mound at the left bank of the Sul-Ab-Warbar. Concentrated within a few square meters were 3 primary core platforms, 1 flake, 1 microblade, and 1 thumbnail scraper.

17. *Garacherach A* (reg. no. H 6). A small open-air site in a hilly area north of the village of Kahreh. The area, covering approximately 2 km^2, consists of three elongated hills, about 140 m high, separated by two minor streams, and originally covered with oak scrub little of which remained. On the eastern hill, in front of a large stone, 1 small flake core, 2 flakes, 1 denticulated flake, and 1 small scraper made on a primary core tablet were found. The artifacts were all made from the same piece of flint, suggesting that the site had been used for flint-knapping.

18. *Garacherach B* (reg. no. H 5). A small open-air site about 300 m southeast of Garacherach A. Within an area of 2 x 2 m, seven flint artifacts were collected: 3 small flakes, 1 secondary core platform, 2 flake cores, and 1 microblade core.

19. *Saimarreh A* (reg. no. H 51). A concentration of eighteen flint artifacts found on a small natural mound between the village of Allahguli and the Saimarreh, approximately 120 m north of the river[5]: 2 flake cores, 2 primary core tablets, 7 retouched flakes, 3 notched blades, 1 backed bladelet, 1 polyhedric burin, and 2 thumbnail scrapers.

20. *Saimarreh B* (reg. no. H 52). An open-air site on a hilltop at the right bank of the Saimarreh, rising about 25 m above the riverbed (Mortensen 1974a: Fig. 18). Within an area of about 19 x 15 m a concentration of 134 flint artifacts were found (Mortensen 1974a: Fig. 19). The material included 12 flake- and blade cores, 3 retouched blades, 7 retouched flakes and blades, 2 backed bladelets, 4 borers, 2 burins, 71 notched blades, and 33 small scrapers. It is noteworthy that none of the scrapers are so-called thumbnail scrapers.

21. *Saimarreh C* (reg. no. H 53). A small open-air site on the right bank of the Saimarreh, about 30 m above the riverbed, and approximately 300 m northwest of Saimarreh B. Three small flake cores, 5 retouched flakes, 1 notched flake, 3 small scrapers, and 1 retouched rod (as depicted in Hole and Flannery 1967:159, Fig. 6n) were found.

22. *Saimarreh D* (reg. no. H 61). An open-air site on a hill, situated on the right bank of the Saimarreh, about 20 m above the riverbed. Thirty-three flint artifacts were found within an area of 5 x 10 m on top of the hill. The material comprised 4 flake cores, 18 flakes (11 of which were retouched), 4 notched flakes and blades, 6 end-scrapers including two thumbnail scrapers and one scraper with a concavo-convex edge, and 1 single-shouldered point.

23. *Tepe Sadazuord* (reg. no. H 60). An open-air site on top of a natural, rocky hill on the plain, about 1 km southeast of Kahreh. Thirty-five flint artifacts collected on the surface included 3 flake cores, 18 retouched flakes and blades, 8 notched flakes and blades, and 6 small scrapers, three of which had a concavo-convex edge.

24. *Sar Sarab B* (reg. no. H 93). An open-air site on the headland protruding from the left bank of Rud Kahreh, ca. 200 m northwest of Sar Sarab A. One hundred and nineteen flint artifacts were found within an area of approximately 30 x 40 m: 8 flake- and blade cores, 6 primary and secondary core

tablets, 18 flakes without retouch, 41 flakes and blades with retouch, 29 notched flakes and blades, 3 burins, 2 borers, 1 scraper made on a core, and 11 scrapers, including six thumbnail scrapers.

In the introduction to this section, I referred to the difficulties we faced in attempting to separate an earlier, Upper Paleolithic industry (Baradostian) from the Epipaleolithic (Zarzian) materials represented in our surface collections. Another problem, related to the survey, was the fact that geometric microliths and microblades were rare in the Zarzian surface collections. In many cases the microflints were probably washed down from the slopes and hills on which the larger cores, notched blades, thumbnail scrapers, and shouldered points were found. The problem is clearly demonstrated by the rather large-sized pieces in the 1973 collections from the surface at Mar Gurgalan Sarab (Fig. 6.13) and Mar Ruz (Fig. 6.16), as contrasted with the excavated materials from the two sites (Figs. 6.15 and 6.18).

Although the material from most of the Epipaleolithic sites in Hulailan is too limited to be ascribed with certainty to an earlier or later part of that period, it is my impression that at least the excavated materials with geometric microliths from Mar Ruz and Mar Gurgalan Sarab—and probably most of the other collections—belong to the recent stage of the Zarzian industry, as defined at the type site (Garrod 1930:15; Wahida 1981:19ff.), and confirmed by the sounding at Ghar-i Khar near Bisitun (Smith 1971:691), and at Warwasi Rockshelter (Olszewski, this volume).

The Epipaleolithic caves and shelters were all concentrated within an area of approximately 12 km^2 in the hilly western part of the Hulailan Valley. With one exception, the open-air sites were found toward the south, the four most important being along the Saimarreh River, about 5-10 km from the caves.

Two of the caves, Mar Gugalan Sarab and Dar Mar, were so large that they might tentatively be identified as seasonal base camps for a band of hunters, consisting possibly of 20-25 persons. The caves were situated near brooks or springs with fresh water, and they both had a fine view of the passing game toward the south. Like some of the caves near Khorramabad, which after excavation were interpreted as base camps, the two Hulailan caves "are located at the boundary between two distinct hunting and gathering areas, such as the talus contact zone between the valley floor and one of the more extensive limestone ridge systems" (Hole and Flannery 1967:162).

The other caves and shelters were too small to serve as base camps for two or three families, and the finds were too limited, suggesting rather that they were used occasionally by a few hunters as shelters against the weather or as transitory stations for espying game. The position and modest size of the open-air sites along the Saimarreh indicate that they were used temporarily by fishers or hunters waiting for animals to appear at the river. Other very small sites, such as Garacherach A-B, Tepe Sadazuord, and Warbar, were obviously used on one or two occasions for flint-knapping.

Naturally, the greatest concentration of Epipaleolithic single finds (thumbnail scrapers and single-shouldered points) occurs in the hilly area with caves and open-air sites near Kahreh and Sar Sarab, and along the left bank of the Rud Kahreh, between the caves and the open-air sites along the Saimarreh. A few Epipaleolithic flints were found at Tang-i Mikush and Villa in the northwestern part of the valley, perhaps suggesting that we may have missed one or two sites in this area. But it is remarkable that only one very small concentration of flints and one single find appeared in the northern part of the valley along the Sul-Ab-Warbar and the Jazman Rud.

The scarcity of Zarzian remains along the Jazman Rud and the Sul-Ab-Warbar and in the hills between these two streams is particularly interesting. It demonstrates that by the end of the Epipaleolithic period, base camps and temporary stations in the Hulailan Valley were concentrated within a few square kilometers in the southwestern hills and along the Saimarreh River, perhaps reflecting the abundance of useful resources in this area. And it suggests that the pressure on vegetation and wild game was not as heavy as one might have expected by the end of the Pleistocene period in this part of the Zagros Mountains.

NOTES

1. The description of the topography of the Hulailan plain is to some extent based on an unpublished manuscript by Kent V. Flannery, *The Prehistoric Environment of Tepe Guran*, prepared for the final publication of the excavations at Tepe Guran (in preparation).

2. The first survey (1973) was carried out for the University of Aarhus and was sponsored by the Carlsberg Foundation. The second survey (1974) was sponsored jointly by the Carlsberg Foundation and the Iranian Centre for Archaeological Research (see Mortensen 1974a, 1974b, 1975, 1976, and 1979).

3. In 1979 Ian A. Brookes wrote a report, *Geomorphology of the Holailan Survey Area, Luristan, Iran. A Reconnaissance Study*, based on a brief investigation of the valley undertaken in 1978 in correlation with his geomorphological studies of the Kermanshah and Mahi Dasht plains.

4. The size of caves and shelters are indicated by the approximate width at the opening, followed by the greatest depth, and the height at the opening.

5. In his geomorphological report, Ian A. Brookes notes that, in his opinion, the artifacts found at Saimarreh A must be derived from the hills immediately behind the alluvial terrace on which they were found, as this part of the terrace has been overtopped by floodwaters fairly frequently.

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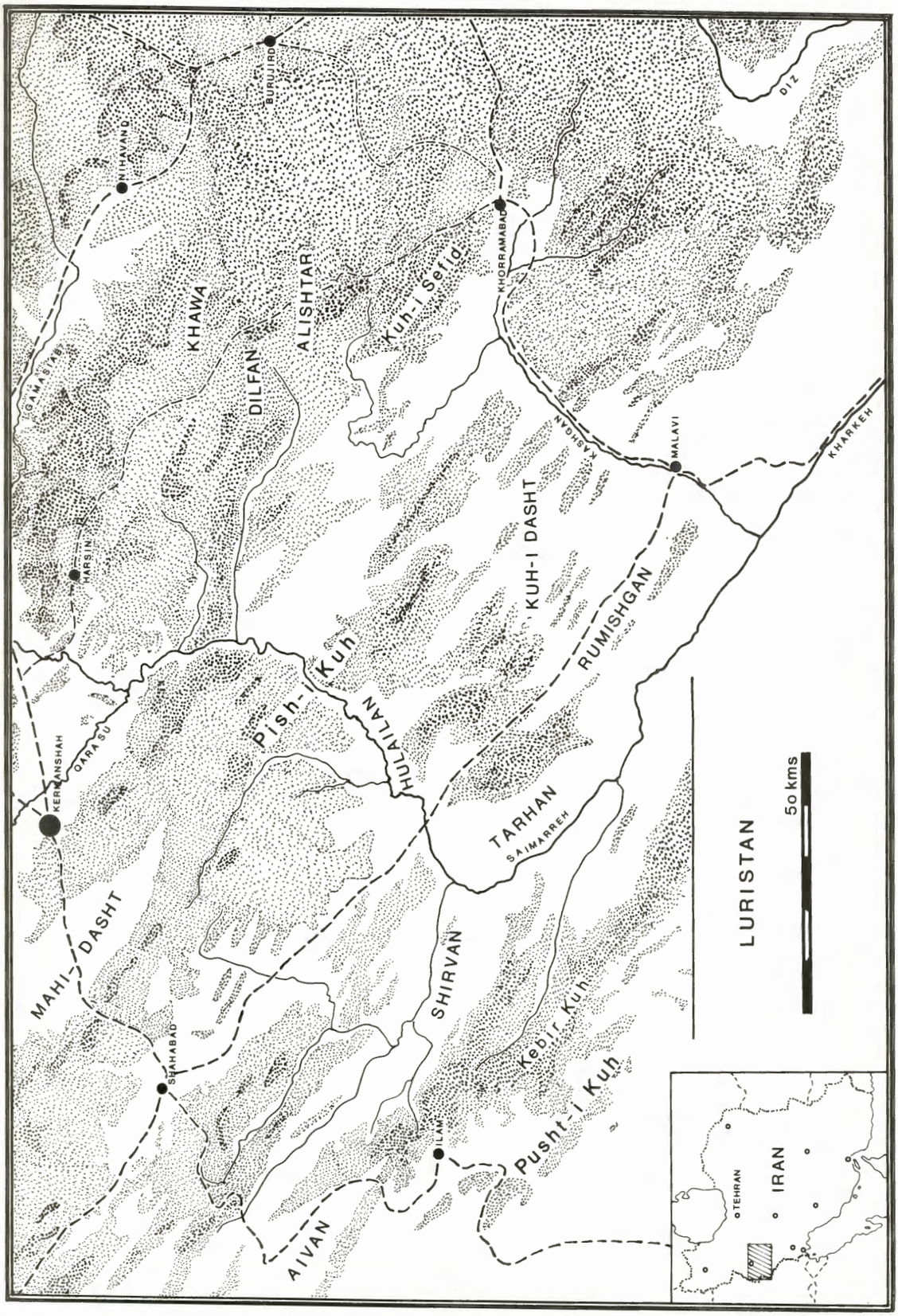


Figure 6.1. Map of Luristan.

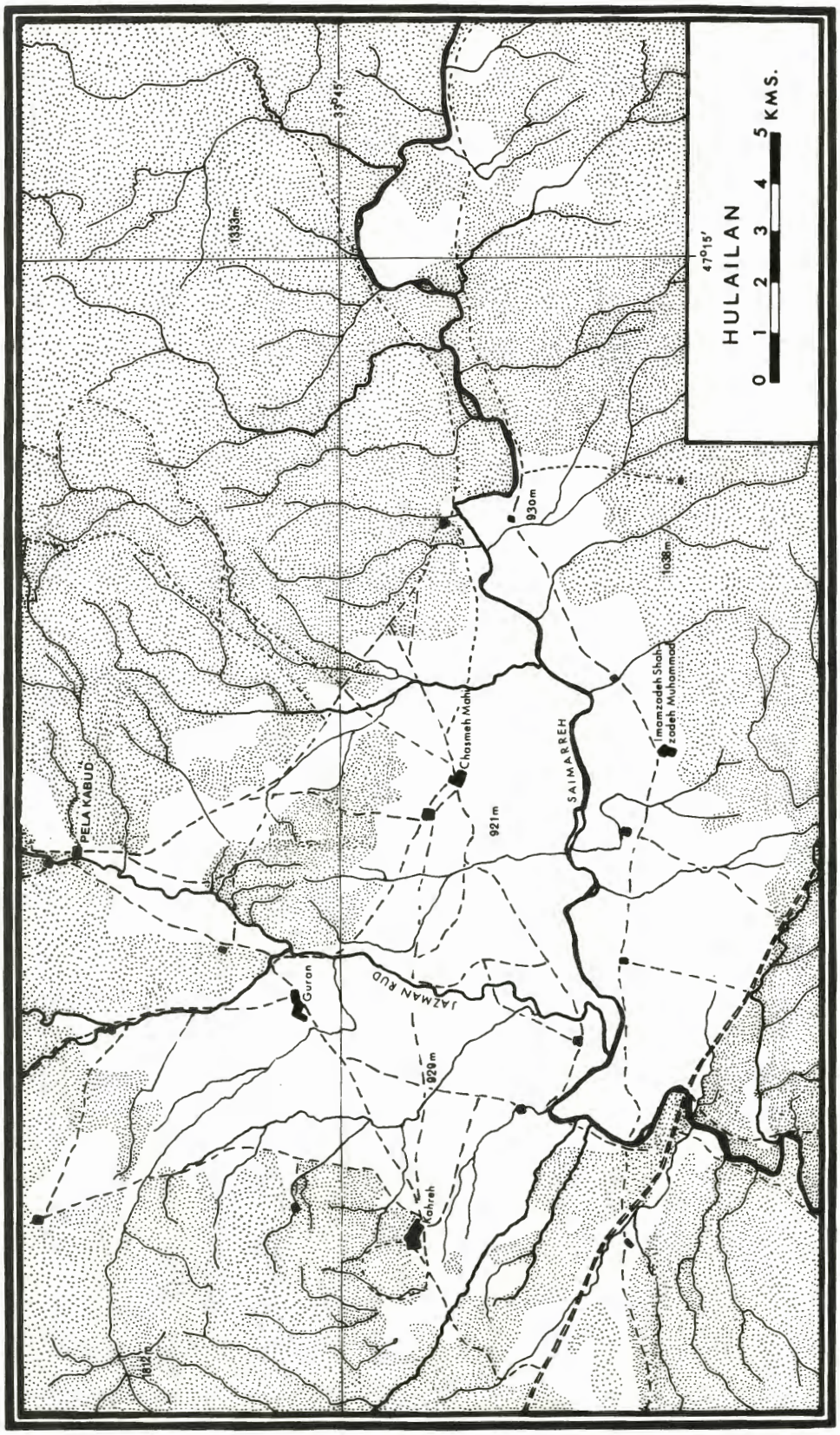


Figure 6.2. Map of the Hulailan Valley, Luristan.

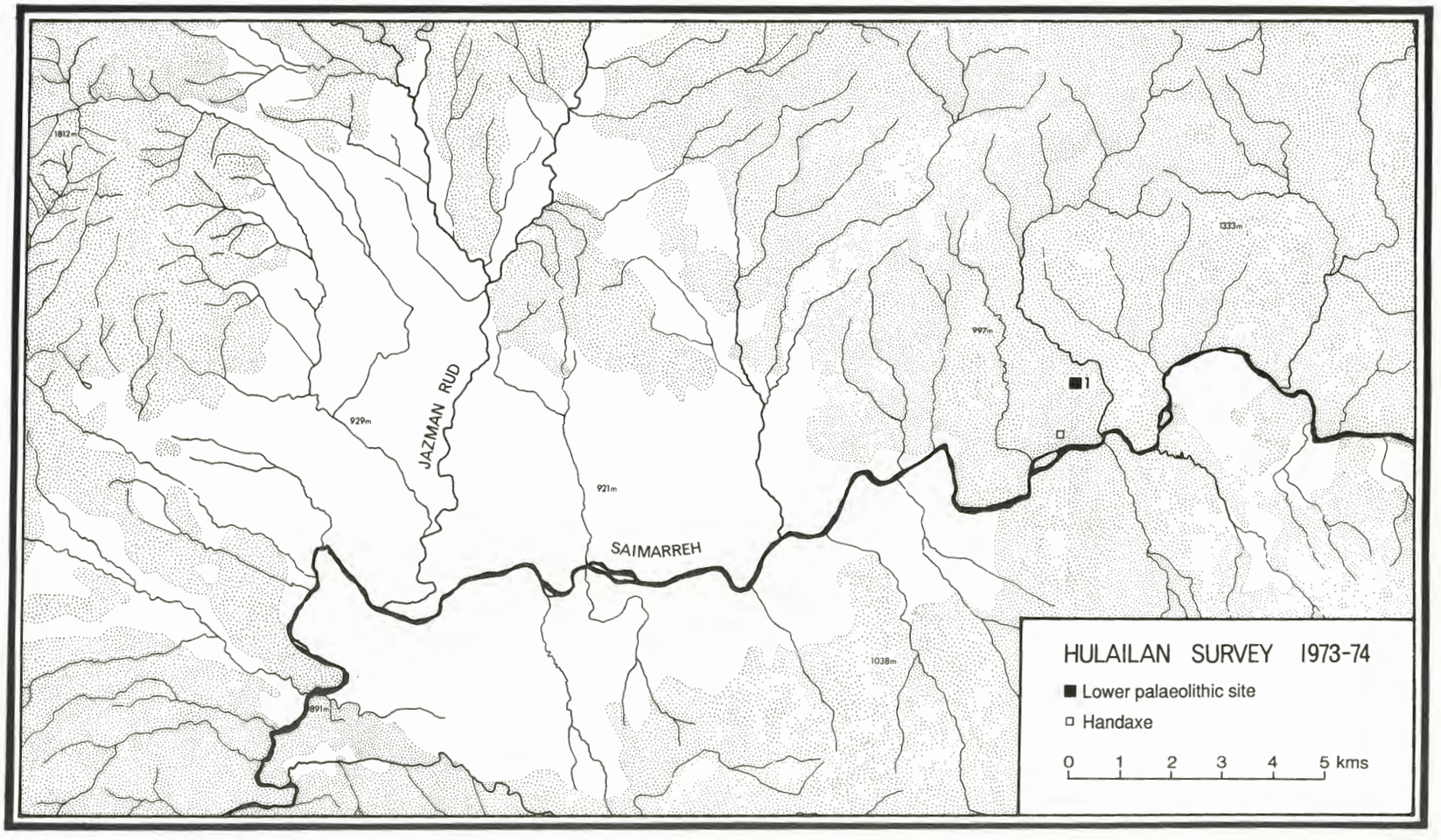


Figure 6.3. *Map of the Hulailan Valley, showing where the Lower Paleolithic site (Pal Barik) and the hand ax were found.*

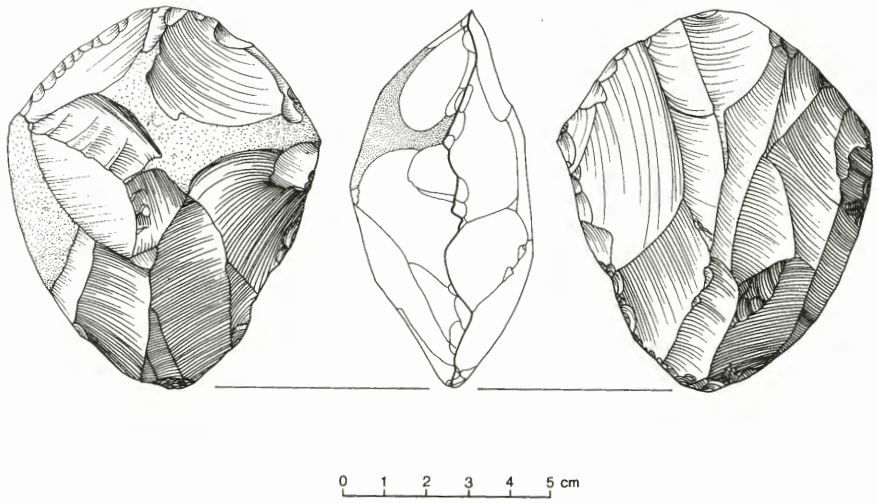


Figure 6.4. Hand ax found north of the village of Sar Cam.

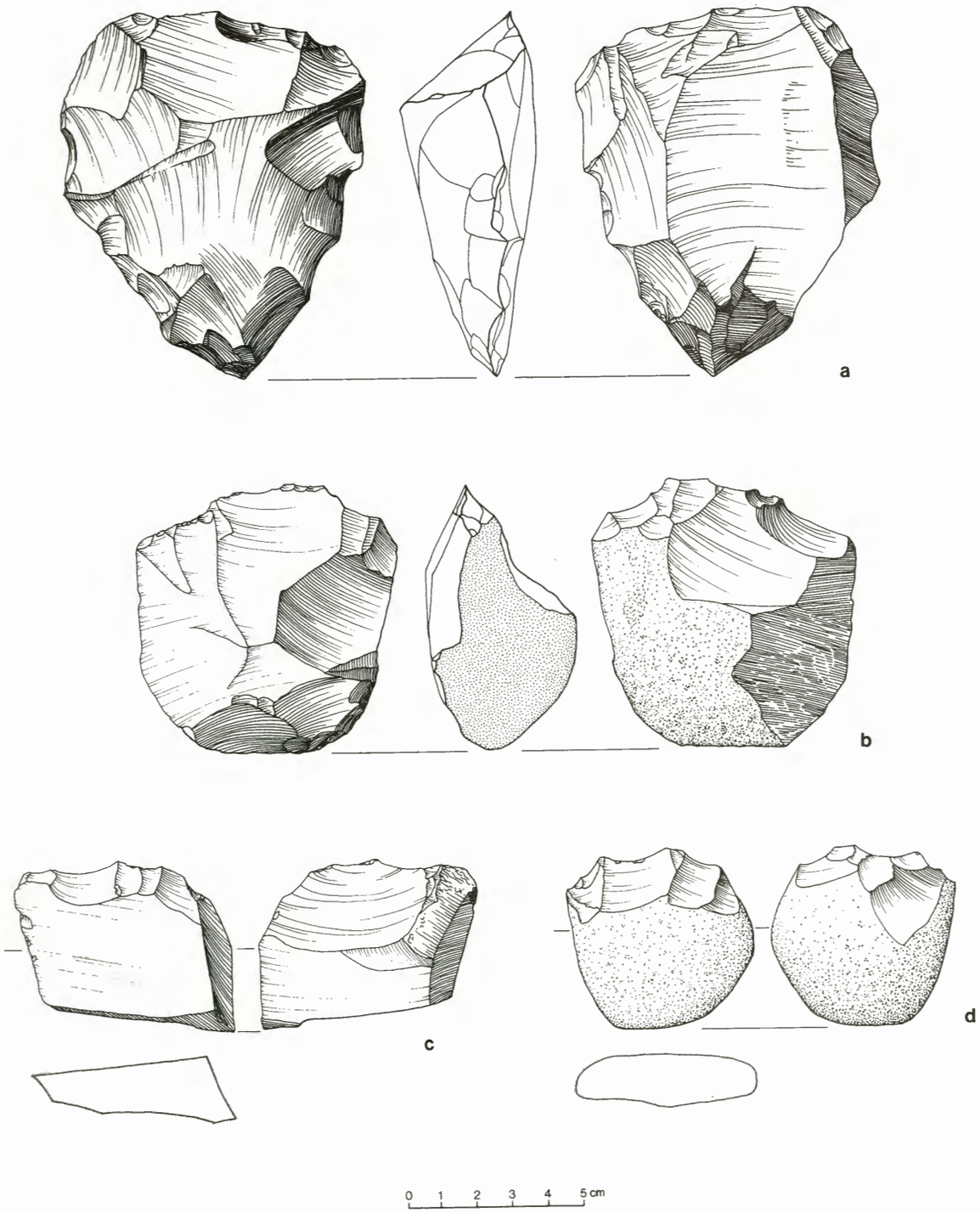


Figure 6.5. Pal Barik: (a) hand ax, (b-d) choppers.

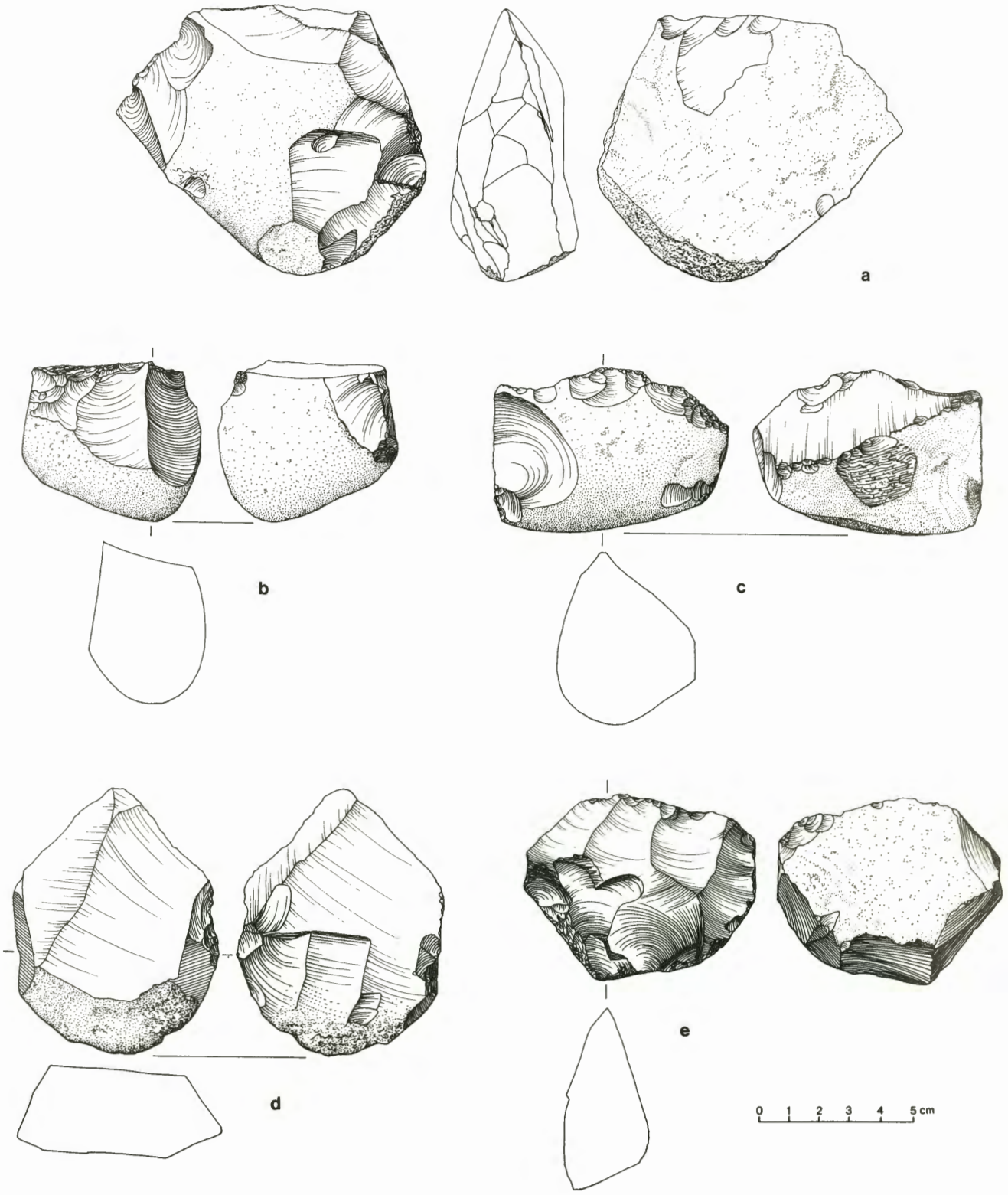


Figure 6.6. *Pal Barik: (a-c) choppers, (d) point made on a core, (e) chopper.*

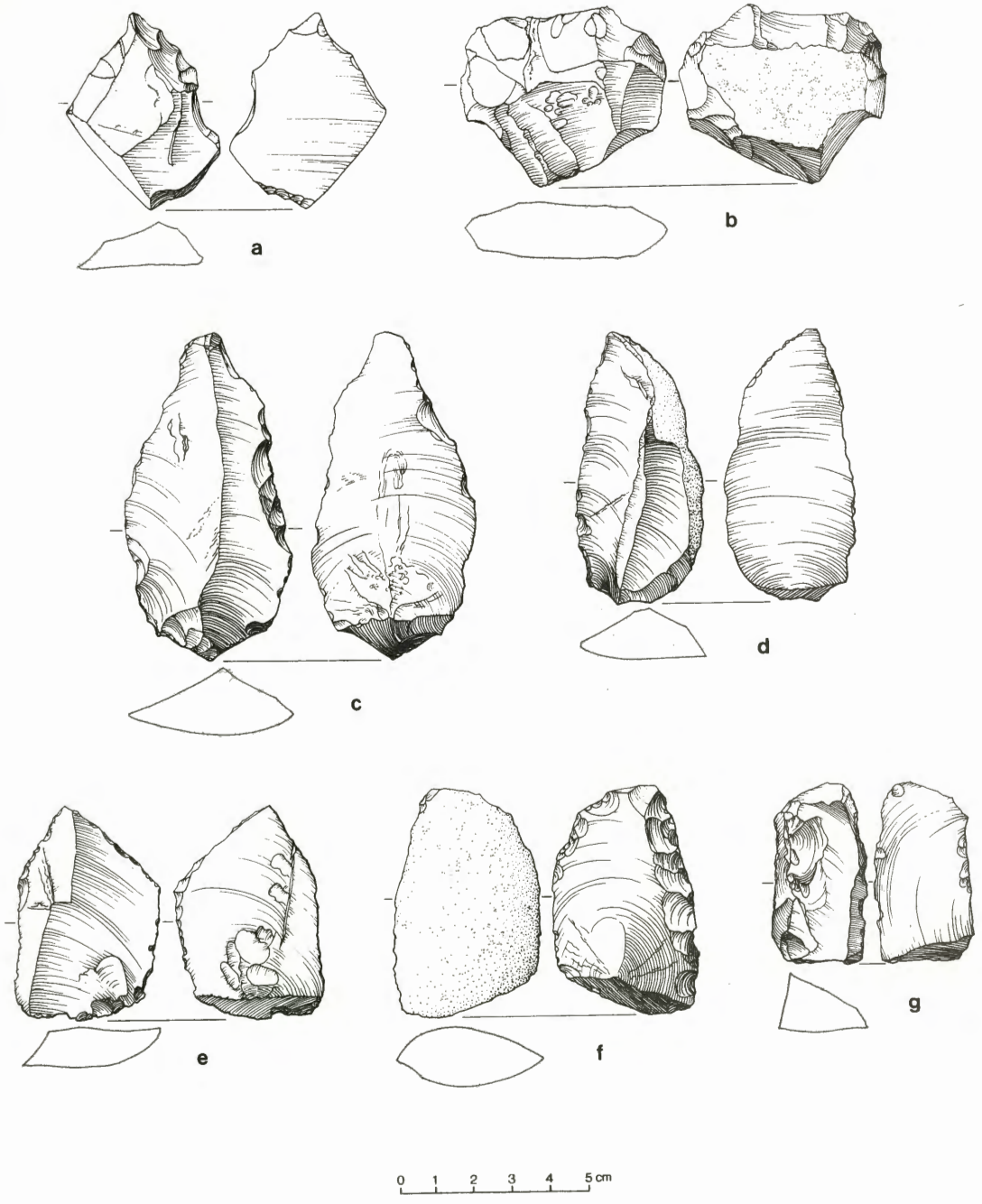


Figure 6.7. *Pal Barik: (a) point, (b) amorphous core, (c-e) points, (f) side-scraper, (g) flakes with irregular retouch,*

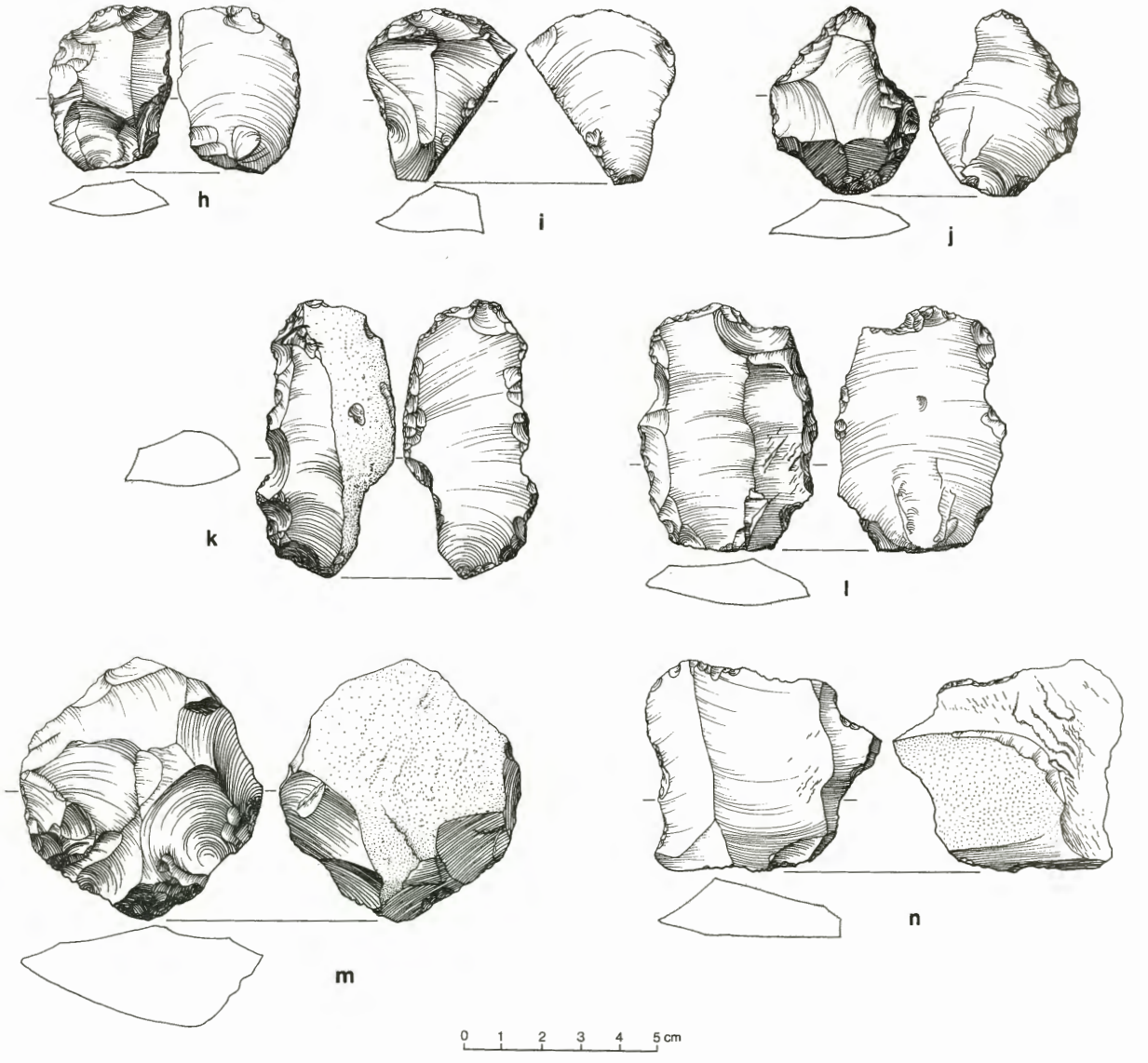


Figure 6.7. (cont.) *Pal Barik: (h) flakes with irregular retouch, (i) end-scraper, (j) flake with irregular retouch, (k-l) notched flakes, (m) discoidal core, (n) flake with irregular retouch.*

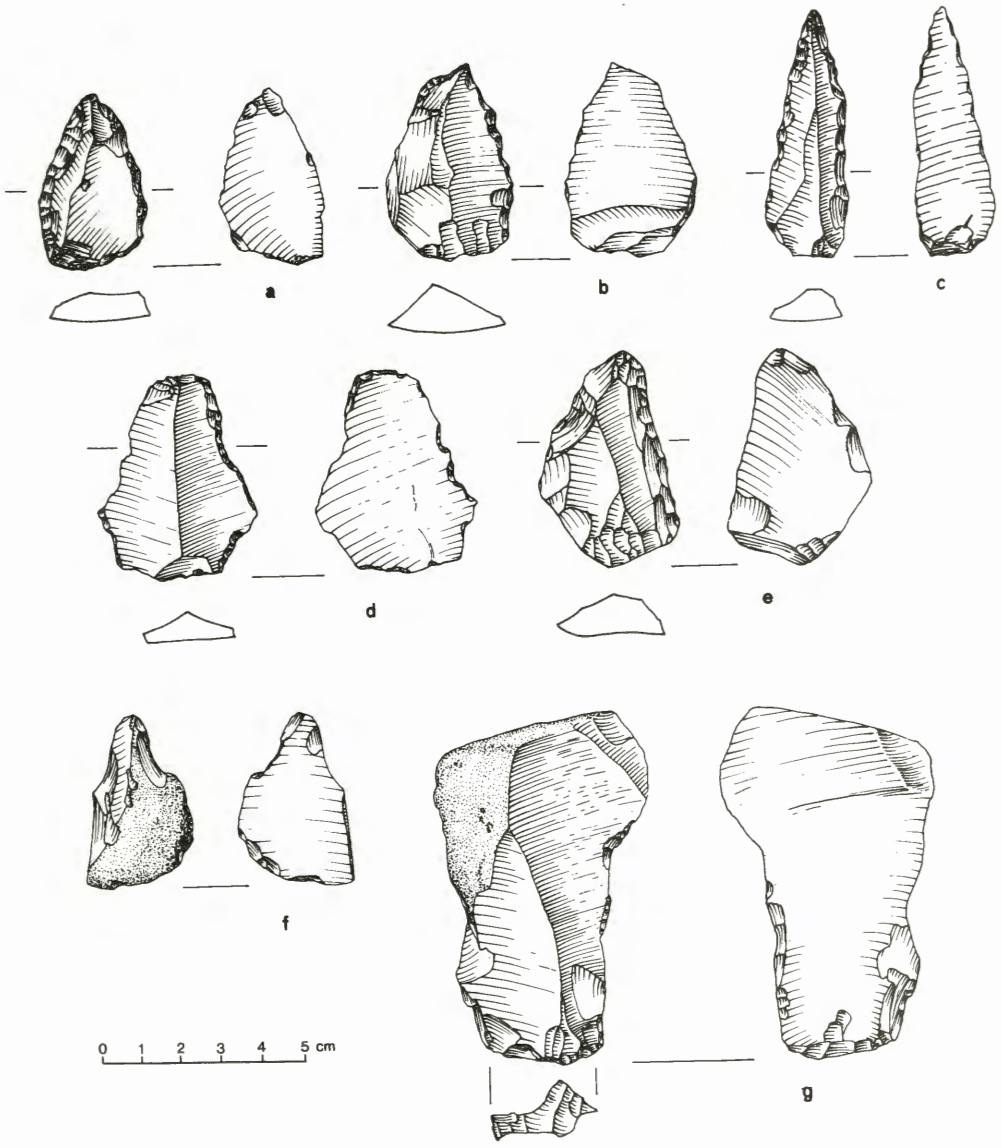


Figure 6.8. *Chesmeh Kahreh: (a-c) Mousterian points, (d) notched flake, (e) scraper with converging edges, (f) borer, (g) retouched flake.*

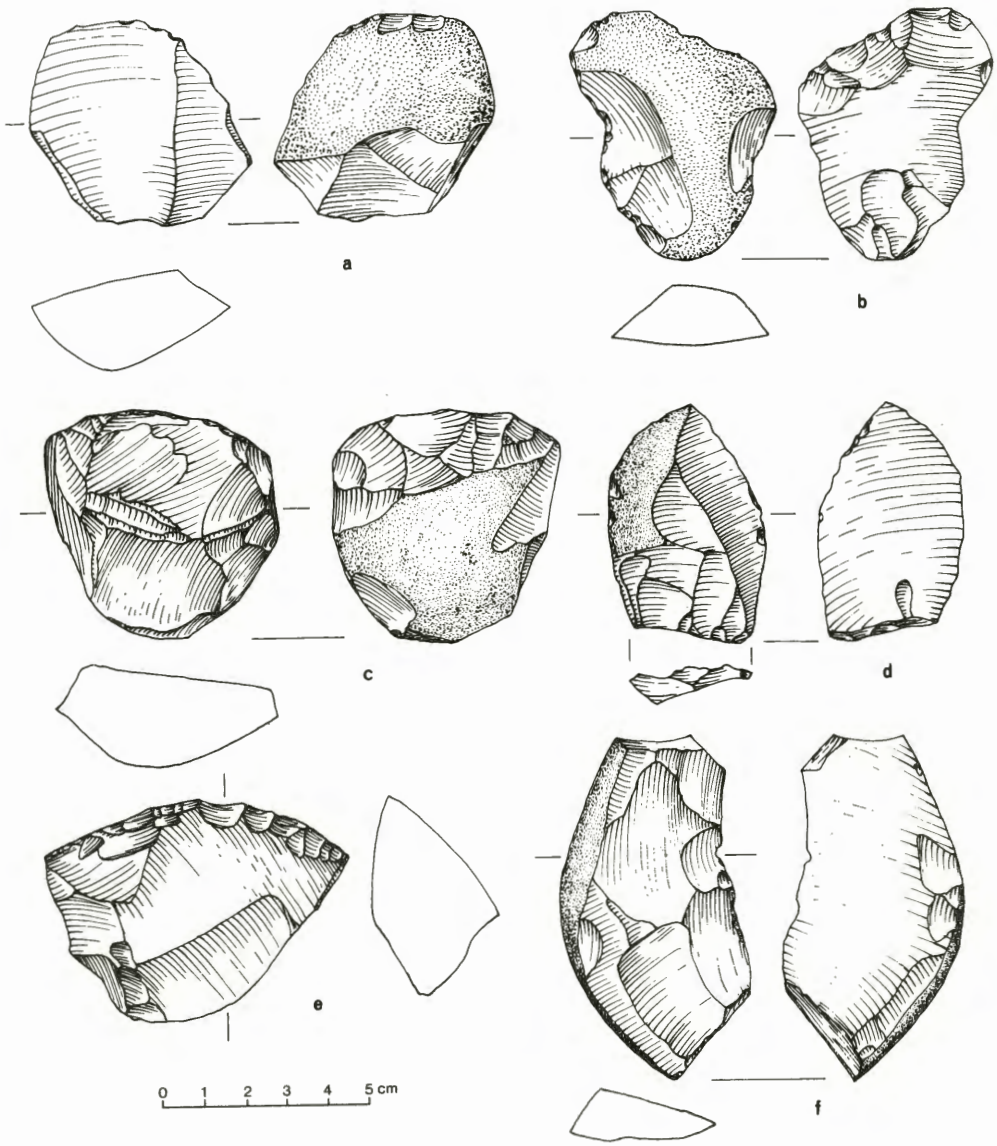


Figure 6.9. *Sar Sarab A: (a) flake core, (b) notched flake, (c) chopper, (d) Levallois point, (e) scraper with a transversal edge, (f) backed knife.*

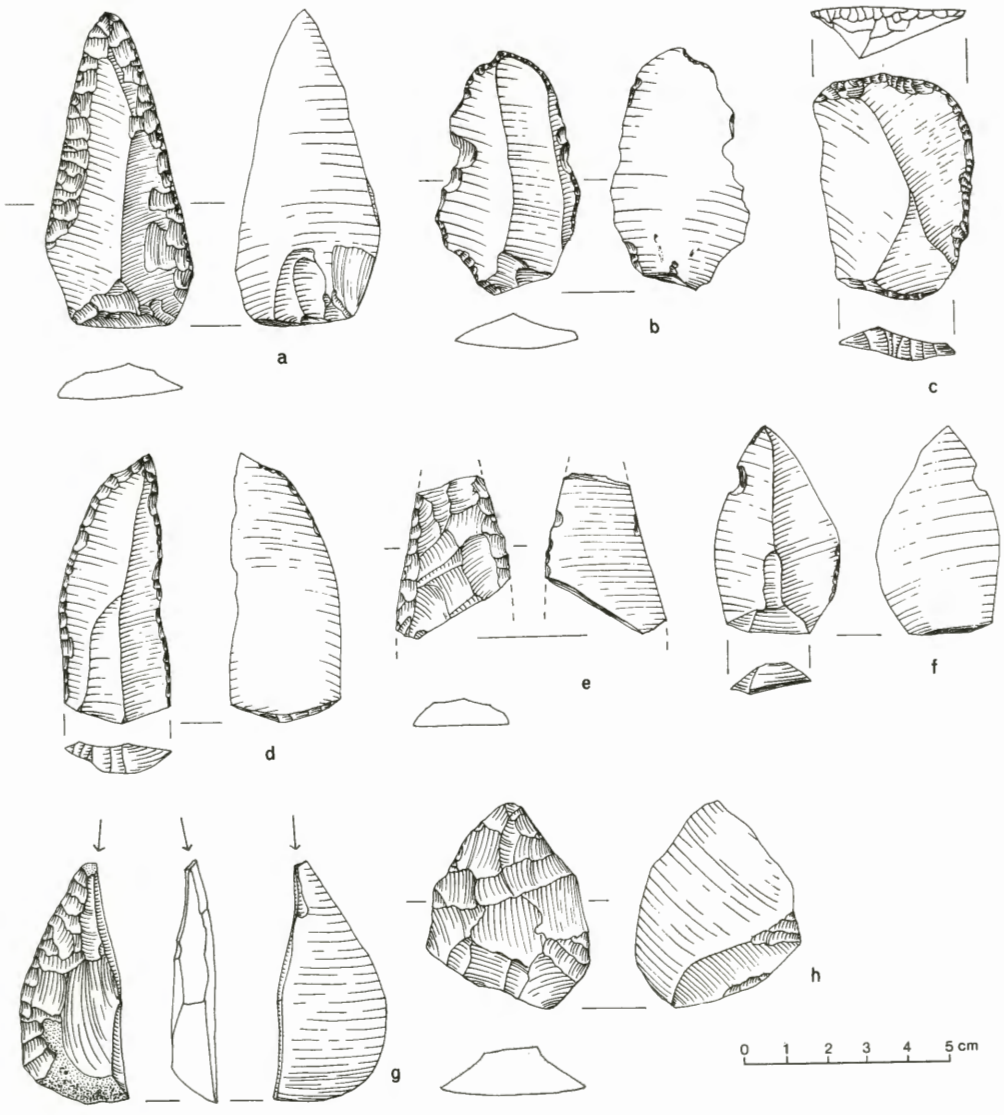


Figure 6.10. *Middle Paleolithic artifacts from Villa (a-b), Garacherach (c-e), Sar Khalijah (d), Ghar Villa (f), Ghar Sefid (g), and Bagh Kahreh (h): (a) Mousterian point, (b) notched flake, (c) scraper, (d-e) Mousterian points, (f) Levallois point, (g) burin made on a broken Mousterian point, (h) Mousterian point.*

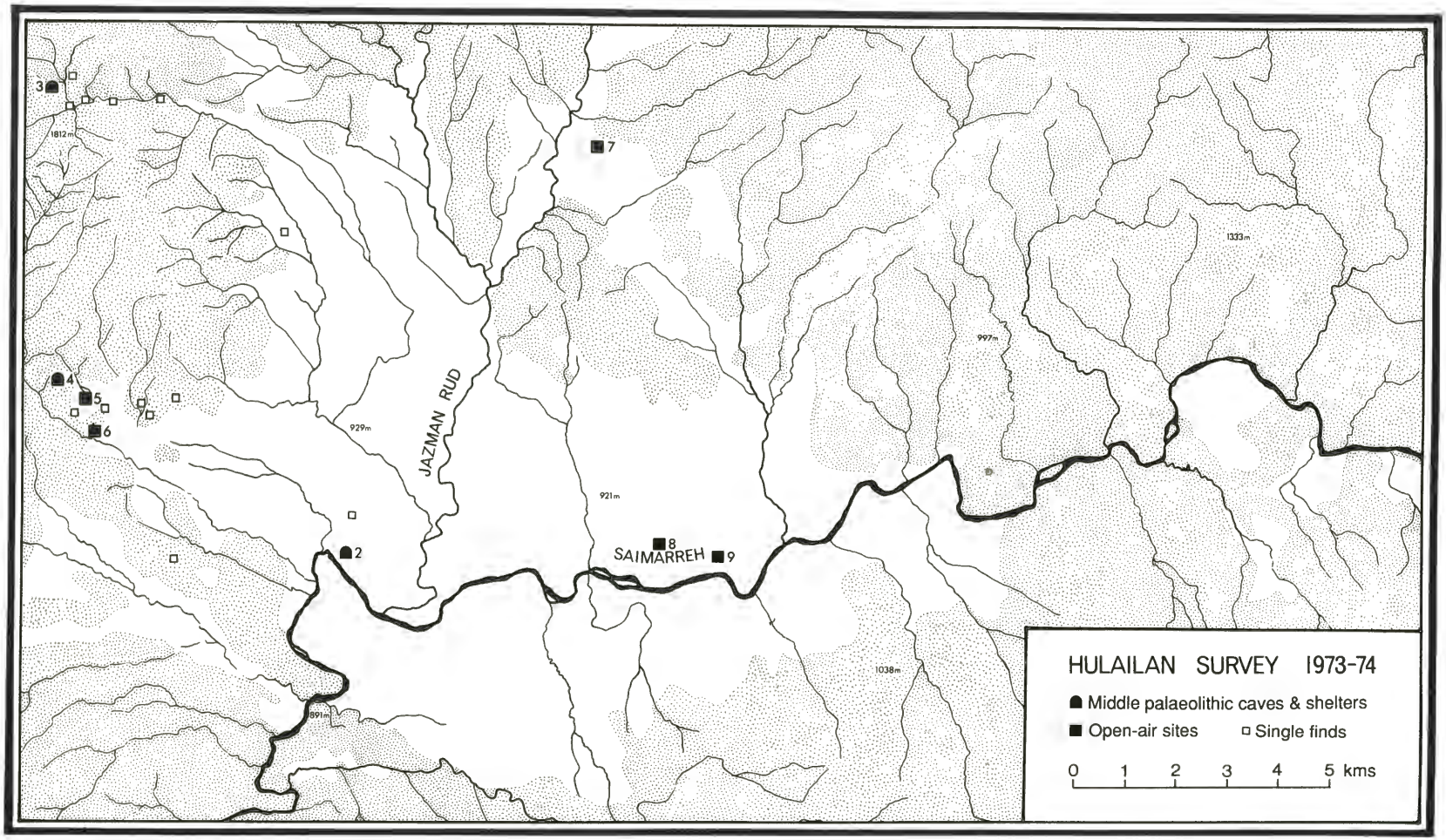


Figure 6.11. Map showing the distribution of Middle Paleolithic caves and shelters, open-air sites, and single finds in the Hulailan Valley.

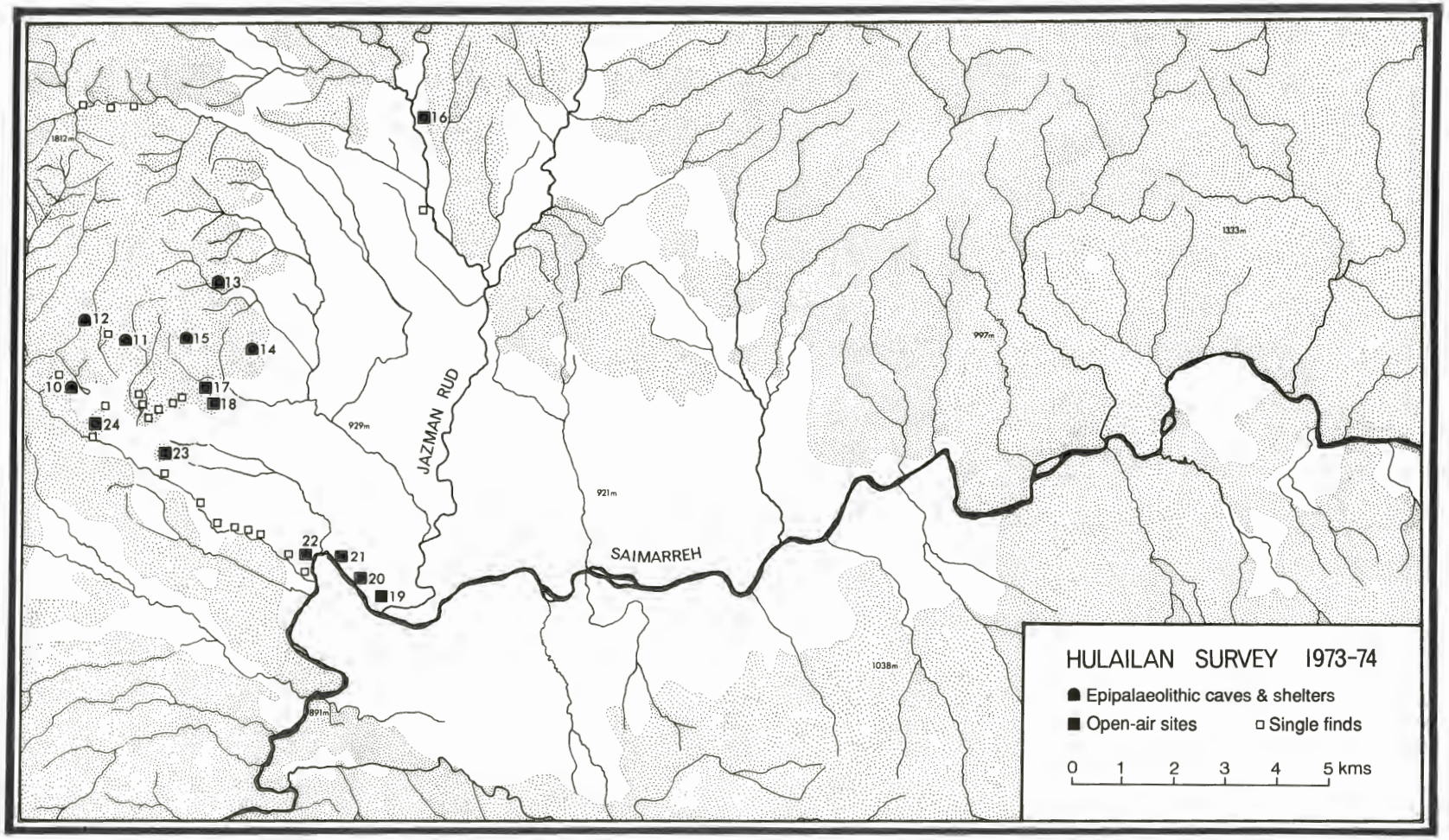


Figure 6.12. *Map showing the distribution of Epipaleolithic caves and shelters, open-air sites, and single finds in the Hulailan Valley.*

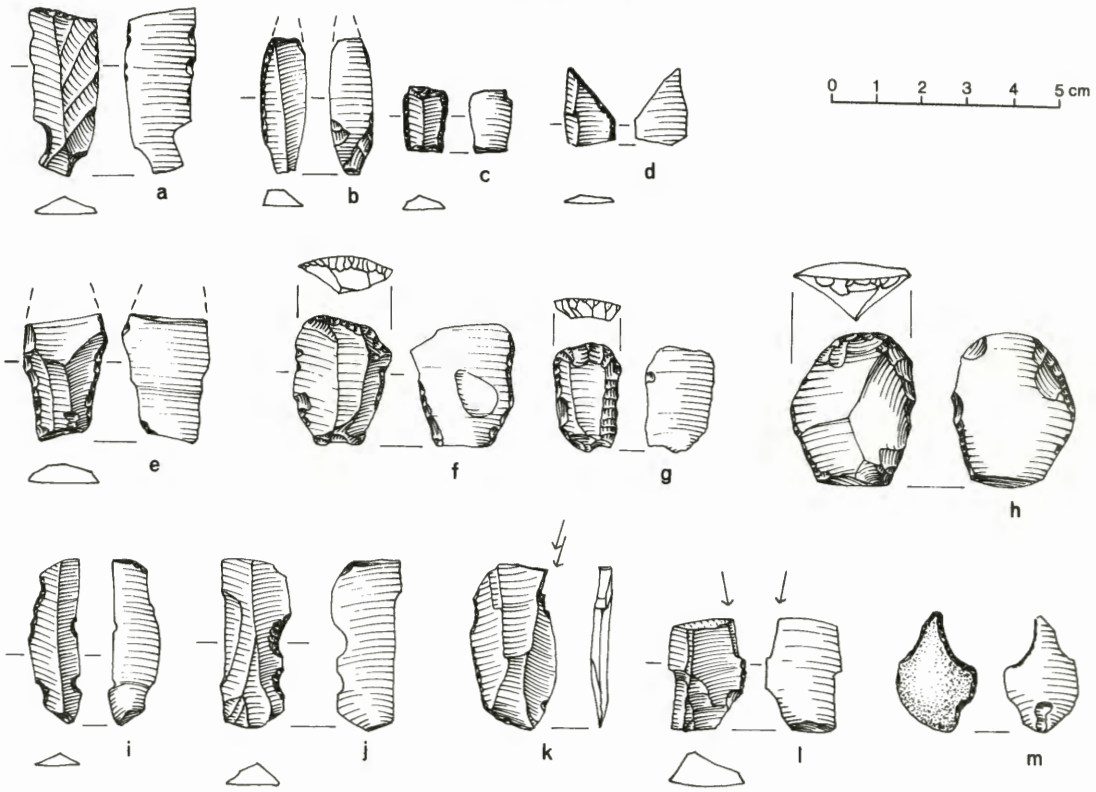
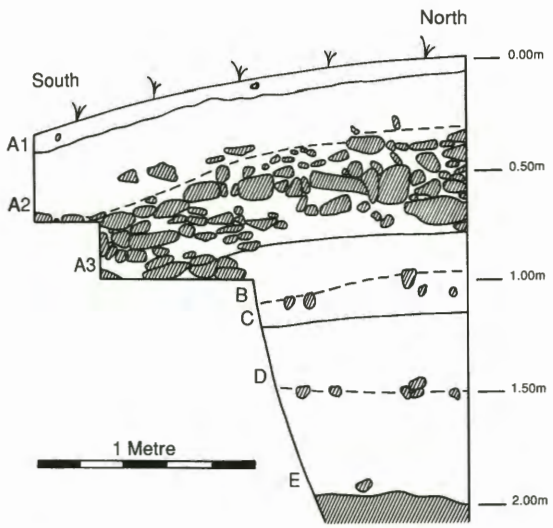


Figure 6.13. *Mar Gurgalan Sarab (surface collection 1973): (a) notched and truncated blade, (b-d) backed bladelets, (e) broken point with a retouched tang, (f-h) end-scrapers, (i-j) notched blades, (k-l) burins, (m) borer.*



MAR GURGALAN SARAB - 1974

Figure 6.14. *Mar Gurgalan Sarab. Western section of a sounding at the entrance of the cave.*

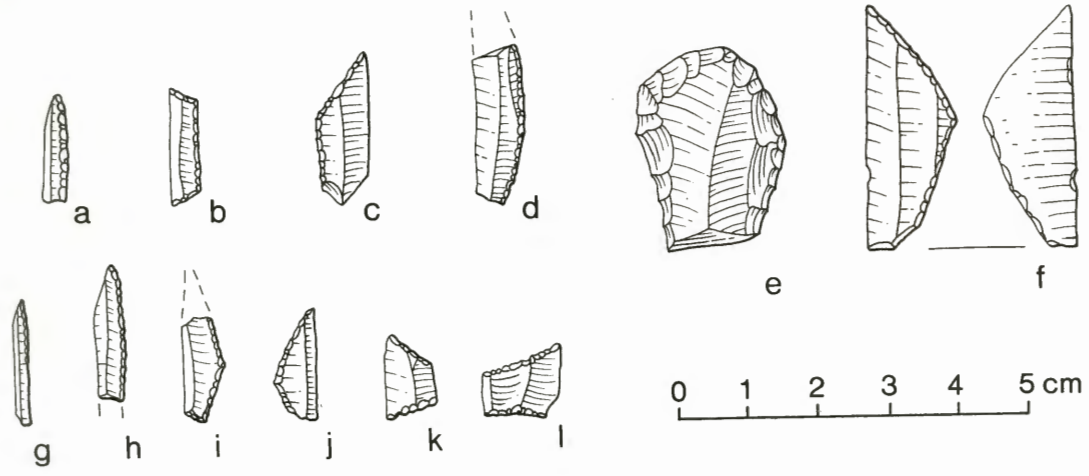


Figure 6.15. *Mar Gurgalan Sarab. Flint artifacts from the Zarzian layers B (e-l) and C (a-d): (a) backed microblade, (b) trapeze, (c-d) backed and truncated microblades, (e) scraper, (f) triangle, (g-h) backed microblades, (i-l) geometric microliths.*

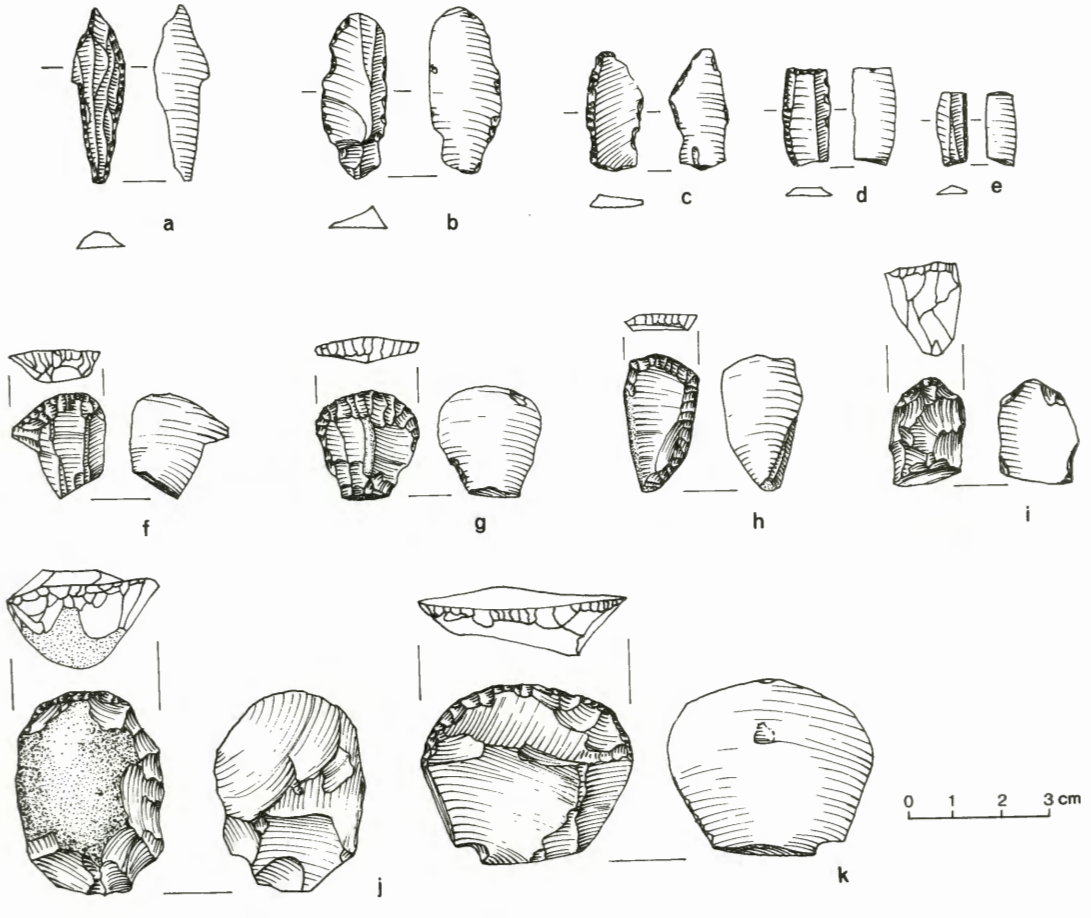


Figure 6.16. *Mar Ruz (surface collection 1973): (a) single-shouldered point, (b) notched blade, (c-e) backed bladelets, (f-k) scrapers.*

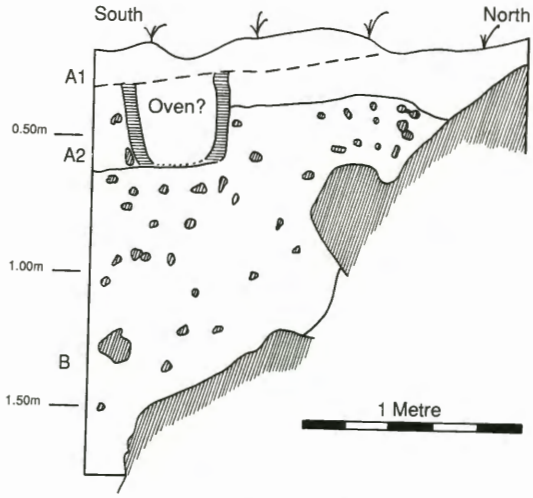


Figure 6.17. Mar Ruz. Western section of a sounding in front of the cave.

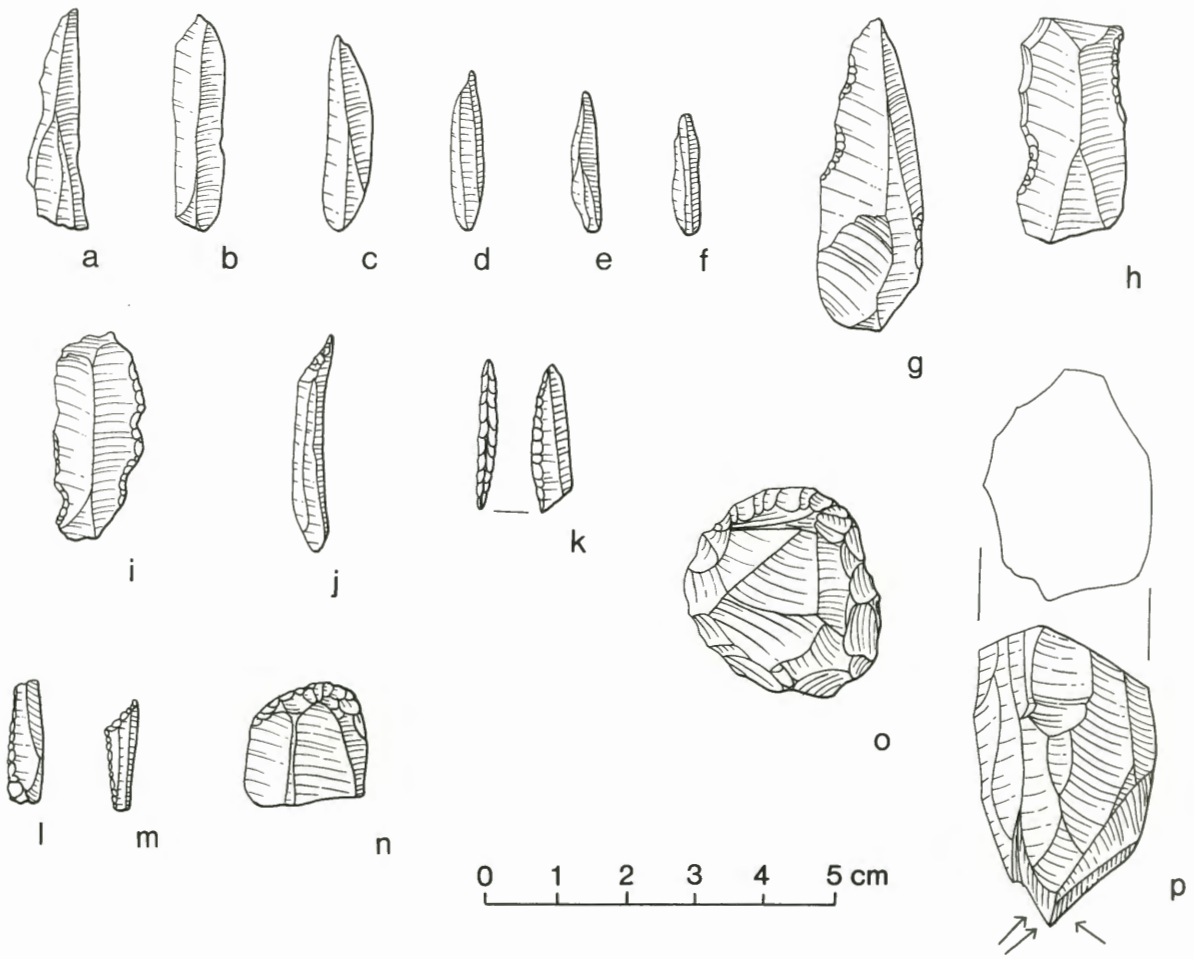


Figure 6.18. Mar Ruz. Flint artifacts from the Zarzian layer B: (a-f) microblades, (g-i) notched blades, (j) microblade with an oblique truncation, (k-m) backed microblades, (n-o) scrapers, (p) polyhedric burin made on a blade core.

7

The Late Baradostian Occupation at Warwasi Rockshelter, Iran[1]

Deborah I. Olszewski

The excavations by Bruce Howe at Warwasi Rockshelter, Iran, in 1960, yielded ten levels with chipped stone artifacts that can be assigned to the late Baradostian Upper Paleolithic tradition.[2] In the Warwasi level sequence, these are Levels P through Z (excluding Level R[3]), which extend from approximately 1.5 to 2.5 m below modern ground surface. Excavation followed arbitrary layers of approximately 10 cm per level; thus the late Baradostian occupation is about 1 m in depth. The test trench was 8 m long and somewhat uneven in width (from 1m to 2 m, in places), roughly approximating a triangular shape. About 8m^3 of sediments were removed from the late Baradostian levels.

Fine-mesh-sieving procedures resulted in the recovery of both large and minute fragments of chipped stone and animal bone. The fragmentary and scanty faunal sample has been previously studied by Turnbull (1975), and will be briefly discussed at the end of this chapter. A study of Levels P-Z by the author resulted in the identification of 14,619 chipped stone artifacts. Of these, 7.8%, or 1148 pieces, are tools. When the lithic artifact data are calculated against the amount of sediment removed from the late Baradostian levels, this set of occupations yields a relatively dense concentration, with approximately 1800 lithic artifacts per cubic meter.

STONE ARTIFACT DESCRIPTION

The late Baradostian chipped stone artifacts were preliminarily classified with respect to the excavation levels. Because there are no radiocarbon dates available, the span of time during which Levels P-Z accumulated is unknown. An initial classification of stone artifacts by level had the potential to facilitate an examination of chronological changes in technology and typology. However, apart from several minor fluctuations in percentages, little difference was noted between these levels in overall assemblage composition. These small differences occur primarily between the earliest (X, Y, and Z) and later levels (P-W).

Thus, Levels Y and Z yielded a few abruptly pointed non-geometric microliths (some of which correspond to el Wad or Gar Arjeneh points), but all levels (P-Z) have relatively high frequencies of inversely retouched bladelets, or *lamelles Dufour* (varying from 31.8% to 71.4%). Observations on the microlith class must be tempered by the fact that the sample size is small for each of the levels (ranging from N=19 to N=45), rendering it unlikely that these differences are statistically significant observations. Scrapers (including side-scrapers) decrease after the first few levels (X, Y and Z), while non-geometric microliths increase. Based on the general similarity of the assemblages of each of the late Baradostian levels, the data from the ten levels are hereafter treated as one analytical unit.

DEBITAGE

Table 7.1 summarizes the debitage information from Levels P-Z. Several points are of interest. First, although all types of debitage, from shatter to core rejuvenation pieces to blades, are

present, cortical flakes and flakes with some cortex are not abundant (5.3%). This can be interpreted either as evidence for initial off-site processing of nodules of raw material or as evidence that cores were heavily reduced on-site, so that the resulting majority of blanks are non-cortical. The second alternative would indicate that few new nodules were introduced into the manufacturing process at Warwasi.

Several other features of the debitage lend support to the interpretation of heavy use of raw materials on-site at Warwasi during the late Baradostian. The presence of a moderate number of both blade(let) and flake core rejuvenation pieces (8.0%) may indicate a fairly intensive use of cores at the site. The large number of retouch flakes (N=1396) may also support heavy reduction, although of tools rather than cores in this case. Burin spalls are not overwhelmingly numerous (4.7%). Their presence in only moderate numbers in a tradition that is defined in part by the abundance of burins may suggest that some "burins" served alternative functions (discussed below). Many of these burin spalls exhibit the retouch of a previous "tool" edge along the primary arête. This may indicate removal of dull tool surfaces, as worn-out tools are refurbished or are used as blanks for new tool types.

Somewhat more equivocal in support of heavy on-site usage of raw materials is the hammerstone class. Only one hammerstone (from Level Q) was identified, and none of the cores exhibit use as a hammerstone. This could also suggest that initial processing of cores occurred off-site, although given the emphasis on blade(let) manufacture, it is just as likely that hard-hammer percussion, which would utilize stone hammers, was not the technique of blank removal used at Warwasi. Soft-hammer, using either wooden or bone/antler hammers, may have been the preferred method.

Blade(let) debitage outnumbers flake blanks by almost a 2 to 1 margin (7733:4046). If the retouch flakes, which are rarely used as tool blanks, are removed from the flake count, this difference becomes even more impressive, an almost 3 to 1 ratio. There are no microburins. Pieces of shatter are relatively infrequent.

CORES

Table 7.2 lists the relevant information concerning the late Baradostian cores (Figs. 7.1 and 7.4). Complete cores comprise 4.3% of the total late Baradostian assemblage. Cores for the production of bladelets are by far the most characteristic of the assemblage as a whole. The emphasis on bladelet manufacture is also evident in that bladelet cores are the most common type within each of the core types, except for the subdiscoidal category, which is dominated by the production of flakes. Single platform cores are the most prevalent type of late Baradostian core, with opposing platforms (same face) a distant second. Small numbers of ninety-degree and opposing platforms (opposite faces) also occur. All other types are very rare.

Given the fact that many of the debitage lines of evidence appear to suggest heavy on-site utilization of raw materials, it is somewhat surprising to find that the tool-to-core ratio is actually quite low (1.8 tools per core, with core fragments excluded). There are several possible interpretations of this ratio. One alternative is that unmodified blanks were used as tools. Macroscopically, such tools would not exhibit formal retouch or "usewear," and thus would go unrecognized as tools within the typological framework.

A second explanation might be that activities at Warwasi were performed using "opportunistic" (informal) tools. These exhibit macroscopic "usewear" in the form of marginal retouch along various edges of blanks, but again are not recognized as tools within formal typological systems. There are 184 such informal "tools" in the late Baradostian levels at Warwasi (recorded within the debitage class). A third alternative is that most tools manufactured at Warwasi were carried away as the occupants returned to other localities. Finally, it may simply be that very few tools were manufactured at Warwasi during the late Baradostian. Any of these views would accord well with the Warwasi occupation representing a limited set of activities, rather than a base camp configuration (Turnbull 1975:146). However, given the generally heavily reduced nature of the lithic assemblage, at present it seems most likely that tools were produced at Warwasi but then removed to other locales.

TOOLS

Characteristically defined as a blade-oriented industry, the Baradostian tool kit is described as dominated by various burins and flake scrapers,

with the additional presence of numerous notched blades and the Gar Arjeneh (el Wad) point (Smith 1986:26; Solecki 1958:110-113). This is exemplified in part by the industry from Shanidar Cave C, which is the basis of the original definition (Solecki 1955:415; 1958:46-50). The late Baradostian assemblage from Warwasi, on the other hand, does not fully accord with the type definition. Table 7.3 presents the major tool classes from Warwasi, Levels P-Z.[4] Representative tools are illustrated in Figures 7.2 and 7.3. A complete inventory of tools by class and type can be found in Table 7.6.

Although the type definition of the Baradostian industry from Shanidar does not feature microliths as a major component, these small tools (non-geometrics) at Warwasi constitute close to 30% of the total tool assemblage. This class is dominated by inversely retouched bladelets, or *lamelles Dufour* (ca. 38% of the microlithic class), which, when combined with alternately retouched bladelets (another type of *lamelle Dufour*), account for almost 50% of the non-geometrics. Another 14.5% are partially retouched bladelets. It is not too difficult to envision the hafting of inversely or alternately retouched bladelets as arrow points or barbs, with existing retouch serving to enhance aerodynamics or penetration.

The data from the microlith class suggests that the occupations at Warwasi P-Z belong within the late phase Baradostian category of Hole and Flannery (1967:157-58). This interpretation draws some strength from the fact that few of the Warwasi microliths are Gar Arjeneh points (el Wad), which are more characteristic of the early Baradostian, whereas a great many of the Warwasi microliths are Type A (inversely retouched, or *lamelles Dufour*), a typical form in the late Baradostian (Hole and Flannery 1967: Fig. 2, 152).

Given that the type definition of the Baradostian emphasizes the importance of burins, it is not surprising to find that burins at Warwasi are well represented, being the second-most-frequent tool class. Within this category, polyhedric (or carinated) burins are the most common, at 49.8%. These are distantly followed by offset dihedrals (28.9%) and burins off oblique truncations (9.2%).

Single notches with interior retouch in the notch and denticulates are relatively equal in representation within the notch/denticulate class. There are also a variety of retouched flakes and blades. Contrary to the type Baradostian definition, scrapers are not a major component of the Warwasi assemblage. However, of the scrapers present at Warwasi and in accordance with the type definition, flake end-scrapers are the most common form. Other moderately frequent scraper types are end-scrapers on blades and microcarinated scrapers. The special tools category refers primarily to side-scrapers, with some examples of *pièces ésquillées*.

The overall blade orientation of the Baradostian is exemplified by the collection from Warwasi, because not only is blade(let) debitage the most frequent, but blade(let) blanks are preferentially used to manufacture tools (59.5% of all tools). Non-cortical flakes and flakes with some cortex are less often selected for manufacture of tools (37.9% of all tools).

A CLOSER LOOK AT BARADOSTIAN BURINS

Two versions of the Warwasi late Baradostian data are presented in Table 7.4. The number and percentage columns on the left refer to the classification of the stone tools according to standard typological methodology. This classification emphasizes both burins and microliths. Scrapers are only a minor component. The numbers and percentages on the right are those if the polyhedric/carinate burins are removed from consideration as tools. The removal of these types of burins, from such a large sample of tools, basically alters only the relative importance of burins in the assemblage. Other tool classes retain their relative positions in terms of abundance/scarcity.

The focus in this discussion is on the category of burins, as these are one of the hallmarks of the Baradostian. In the examination of the Warwasi collection, it became apparent that almost half of the burin category consisted of various polyhedric/carinate burins. These are commonly manufactured on both blade and flake blanks, and are typified by 1-2 spall removals along one lateral. This lateral then serves as a "platform" from which three or more spall removals occur, usually across the interior face of the flake or blade blank (Fig. 7.4 a-c). This is a similar, if not identical, pattern to that which occurs on single platform bladelet cores. The cores exhibit the removal of one end of a nodule in order to prepare a striking platform. From this platform, numerous bladelets are struck off the core (Fig. 7.4 d-e). The similarity of polyhedric/carinate burins to single plaform cores is also exemplified by instances of classification of such cores as

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